TM 10-1341

182391

MAINTENANCE MANUAL

CHEVROLET

1½-TON (LC) 4 x 2 TRUCK

Built for

UNITED STATES ARMY

MODEL 4109

CONTRACT NUMBER
W-398-QM-11200

U.S.A. Registration Numbers
W-363437 to 364187

Chevrolet Motor Division
General Motors Corporation
Detroit, Michigan

TM 10-1341

MAINTENANCE MANUAL

CHEVROLET 1½-TON 4 x 2 TRUCKS

FOREWORD

This manual contains information covering the Operation, Maintenance and Repair of Chevrolet 1½-Ton — 4 x 2 Trucks.

For the convenience of the user it is arranged in sections. All information pertaining to a given unit will be found in the section devoted to that unit. The manual is written for the guidance of the operator and repair men who are responsible for the vehicle. Keep it handy and refer to it often.

CHEVROLET MOTOR DIVISION
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SECTION INDEX

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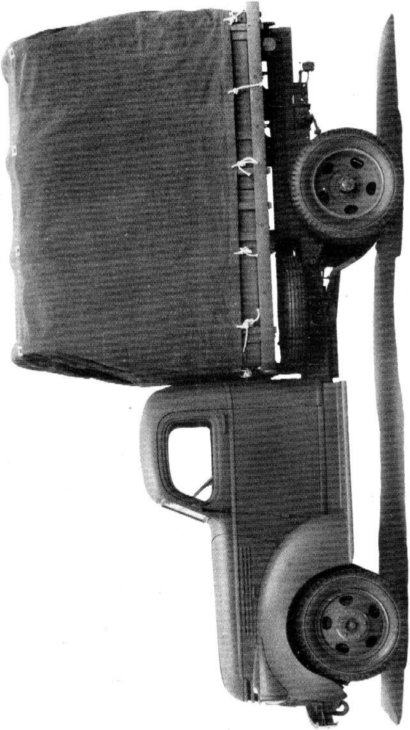

Section 0

DRIVER INSTRUCTIONS

It is of definite importance that the driver of one of these vehicles be thoroughly familiar with the various controls and instruments and their proper use. Even the experienced driver should study the controls before attempting to start the engine or move the vehicle.

Fig. 1 illustrates the controls and instruments; in the following paragraphs dealing with the purpose and use of the instruments and controls we will refer to the key number of the instrument or control being discussed, so the reader may easily follow the instructions. Starting with Fig. 1 we find the following:

IGNITION SWITCH No. 1 is operated by the ignition key; turning the switch to the right turns on the ignition and turning the switch to the left turns the ignition off.

HAND THROTTLE No. 2 is located on the instrument panel to the right of the ignition switch; pulling this button opens the throttle. This control may be used when starting or, if it is desired, to run the engine at a constant speed.

CARBURETOR CHOKE No. 3 is used when starting a cold engine. Pulling out this control button shuts off the air to the carburetor, providing a rich mixture for easy starting. The choke button should be pushed in when the engine starts. If the engine is warm, the use of the choke should be unnecessary.

FUEL GAUGE No. 4 registers the amount of fuel in the tank when the ignition switch is turned on. The dial has graduations for empty, half full and full.

TEMPERATURE INDICATOR No. 5 indicates the temperature of the liquid in the cooling system at all times. The driver should watch this instrument closely. A red band at the right of the dial is used to indicate excessive temperature. Whenever the indicator hand enters this band, the driver should immediately investigate the cause of the excessive temperature. Continuing to drive an overheated engine may cause permanent damage to its working parts.

AMMETER No. 6 is used to indicate whether the battery is being charged or discharged when the vehicle is in operation. If the ammeter shows discharge at all times, the cause should be investigated and corrected, otherwise the battery will be discharged.

OIL GAUGE No. 7 indicates the oil pressure. The dial has three divisions showing 0, 15 and 30. The driver should watch this instrument closely and, if the indicator hand drops below zero, the engine should be stopped immediately and the cause of the oil pressure failure investigated and corrected before continuing to run the engine.

SPEEDOMETER No. 8 indicates the speed at which the vehicle is being driven. The odometer registers the total number of miles the vehicle has been driven.

LIGHTING SWITCH No. 9 controls the lighting circuits. When the switch button is pulled out to the first position, it turns on the parking lights and tail light. Pulling the switch button all the way out turns on the headlights; the tail lamp is also turned on in this position.

WINDSHIELD WIPER SWITCH No. 10 is used to turn the windshield wiper on or off, by turning the button alongside the switch.

WINDSHIELD QUADRANT ADJUSTING SCREWS No. 11 are used to lock the windshield at various degrees of opening.

GLOVE COMPARTMENT LOCK No. 12. Pressing downward on the glove compartment lock cylinder opens the glove compartment door. A key is provided to lock this compartment.

ASH RECEIVER No. 13 is for the convenience of the driver; pulling the receiver outward uncovers the tray. The tray may be lifted out to empty the ashes.

VENTILATOR CONTROL LEVER No. 14 is used to open and close the cowl ventilator.

CLUTCH PEDAL No. 15 is used to disengage the engine from the transmission when shifting gears. The clutch pedal should never be engaged quickly when the vehicle is in gear. Driving with foot on pedal will cause wear of clutch facings and throw-out bearing. There should be one to one-and-a-quarter inches of free travel of the clutch pedal before the clutch starts to disengage.

BRAKE PEDAL No. 16. Pressing down on the brake pedal applies the hydraulic brakes at all four wheels. Avoid driving with foot on brake pedal, as brakes will be partially applied and cause rapid wear of lining.

HEADLIGHT DIMMER SWITCH No. 17 is a foot switch used to select the headlight beam (upper or lower) desired after the headlights are turned on, by pressing down on the switch button with the foot. When the upper beam is turned on, the headlight beam indicator is automatically turned on. This is a small red light located below the 50-mile graduation on the speedometer scale. When the lower beam is in use, the beam indicator is turned off. Always use the lower beam when passing approaching vehicles. This is an important highway safety rule in night driving.

INSTRUMENT LIGHT SWITCH No. 18 is used to turn on the instrument and ignition switch light. Moving the switch handle to the right turns on the ignition switch light, while moving it to the left turns on the instrument lights.

ACCELERATOR No. 19 is used in driving to control the speed of the engine.

STARTER SWITCH PEDAL No. 20. Pressing down on pedal with foot engages the starter and flywheel gears and also closes the starter switch, com-

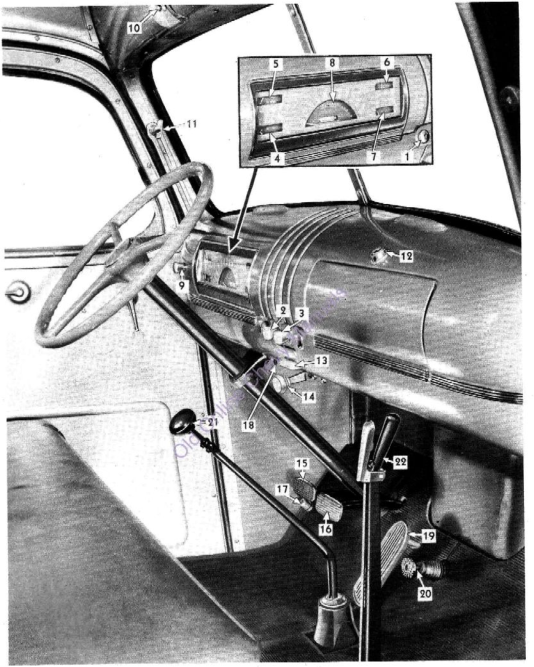

Fig. 1—Interior of Cab showing Location of Instruments and Controls

1—Ignition Switch
2—Hand Throttle
3—Carburetor Choke
4—Fuel Gauge
5—Temperature Indicator
6—Ammeter
7—Oil Gauge
8—Speedometer
9—Lighting Switch
10—Windshield Wiper Switch
11—Windshield Control Handle
12—Glove Compartment Lock
13—Ash Receiver
14—Ventilator Control Lever
15—Clutch Pedal
16—Brake Pedal
17—Headlight Dimmer Switch
18—Instrument Light Switch
19—Accelerator
20—Starter Switch Pedal
21—Transmission Gearshift Lever
22—Hand Brake Lever

pleting the electrical circuit between battery and starter. Rotation of the starter armature through the gears cranks the engine. When the engine starts, foot should be removed from pedal immediately.

TRANSMISSION GEARSHIFT LEVER No. 21 is used to select various gear ratios provided in the transmission. There are four speeds forward and one reverse. Reverse gear can only be engaged when latch on gearshift lever is raised. Lever positions for various gears are shown on the shifting diagram, Fig. 2.

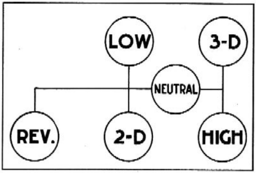

Fig. 2—Four-Speed Transmission Gearshifting Diagram

Half ton Trucks are equipped with a three-speed transmission having three speeds forward and one reverse. Fig. 3, shifting diagram, shows the gearshift lever positions for the various speeds.

HAND BRAKE LEVER No. 22 operates the brakes on the rear wheels mechanically. Whenever the vehicle is parked, the lever should be pulled toward the rear as far as possible. Before moving the vehicle, lever should be in released position.

OPERATING INSTRUCTIONS

Each day the following inspections should be made before starting the vehicle:

1. Check the oil level on the dip stick. If oil is down to the low mark, add oil.
2. Check the water in the radiator, and fill if necessary. Check hose connections for leaks. Check fan belt for looseness.
3. Note condition of tires and see that they are properly inflated.

Starting the Engine

1. Transmission gearshift lever must be in neutral position. See shifting diagram.
2. Pull out hand throttle about ⅜ inch. This is not necessary if engine is warm.
3. Pull out choke button to obtain proper fuel and air mixture for starting. If the engine is warm, choking will be unnecessary.

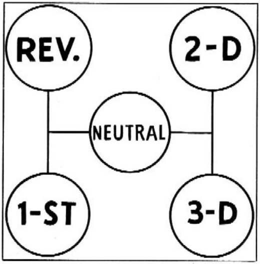

Fig. 3—Three-Speed Transmission Gearshifting Diagram

4. Insert key in ignition switch and turn switch to "On" position.
5. Step on starter pedal to crank the engine. Release pedal as soon as engine starts.
6. Push in on choke button and adjust hand throttle to obtain even idling. When engine is cold, it should be run several minutes before attempting to move the vehicle.

Starting the Vehicle

1. Push clutch pedal downward to disengage the clutch.
2. On four-speed transmissions, move transmission gearshift lever to the left and forward into first gear position; on three-speed transmissions, move the gearshift lever to the left and backward into first gear position—see shifting diagram.
3. Release the hand brake lever.
4. Step down on accelerator pedal to speed up the engine. Release clutch pedal slowly and push accelerator pedal down as necessary to pick up the load and prevent stalling the engine as the vehicle starts to move.
5. As vehicle speed increases, release accelerator pedal, depress the clutch, move gearshift lever to neutral and then to next higher speed. Step down on accelerator and engage clutch as explained above. Repeat this operation until transmission is in high gear.

Shifting to Lower Speed in Transmission

The transmission should always be shifted to the next lower speed before engine begins to labor or before vehicle speed is reduced appreciably. Shifting to lower speed is accomplished as follows:

1. Depress the clutch pedal quickly, maintaining the same pressure on accelerator. Move gearshift lever to neutral and at the same instant engage the clutch.

2. Again depress the clutch pedal and move the gearshift lever to the next lower speed. Engage the clutch slowly and at the same time accelerate the engine speed to synchronize it with that of the vehicle.

It is advisable to use the same transmission gear going downhill as would be required to climb the same hill. This is a safety rule followed by all good drivers in hilly territory.

Shifting into Reverse

Before attempting to shift into reverse, the truck must be brought to a complete stop.

1. Push clutch pedal downward to disengage clutch.

2. On four-speed transmissions, raise latch on gearshift lever and move lever to left as far as possible, then toward the rear; on three-speed transmissions, move the gearshift lever to left, then forward into reverse—see shifting diagram.

3. Engage clutch and accelerate the engine in the same manner as previously explained under the heading "Starting the Vehicle."

Stopping the Vehicle

1. Remove foot from accelerator pedal and apply brakes by pressing down on foot pedal.

2. When speed of vehicle has been reduced to idling speed of engine, disengage the clutch and move transmission gearshift lever into neutral position.

3. When vehicle has come to a complete stop, release clutch pedal and apply hand brake.

GENERAL LUBRICATION

Lubrication of a truck is important to prevent damage to moving parts due to friction, heat or foreign material. As all moving parts are not subjected to the same type of operating conditions the lubricant to be used is that which most nearly meets the requirements of the part involved. In some places excessive heat or cold is the problem to overcome, in others it is extreme pressure, water, sand or grit. The type of operating surface must also be taken into consideration as certain parts rotate or oscillate on bronze bushings, roller bearings, ball bearings or cast iron bearings. Each of the above conditions or constructions make necessary the application of a specialized lubricant.

Lubricants are much cheaper than repair bills and should be applied regularly to secure a maximum of useful service from a truck. Consequently, it is of equal importance that not only the proper grade of lubricant be used but that it be applied in accordance with a definite schedule.

The chart at the end of this section should be referred to for instructions on the mileage of application and the grade and quantity of lubricant required for all parts of the truck. A more detailed account of certain phases of lubrication is given in the following paragraphs.

ENGINE

Oil Gauge

When starting a cold engine, it will be noted that the oil gauge on the instrument panel will register a high oil pressure. As the engine warms up, the pressure will drop until it reaches a point where changes to higher speeds will raise the pressure very little, if at all.

If the oil pressure registers abnormally high after the engine is thoroughly warmed up, an inspection should be made to ascertain if the oil lines and passages are "plugged."

Lubrication

First 500 Miles

Proper selection of the oil to be used will add much to the performance, reliability, economy and long life of an engine.

It is important that the recommended light oils be used in the engine during the "breaking-in" period as they assure ease of starting the engine; prompt flow of a sufficient quantity of oil to the bearings; less friction between moving parts; less wear of moving parts, etc.

The crankcase of the engine, as delivered from the factory, is filled with 10-W oil. This should be left in during the first 500 miles and then the crankcase should be drained (while hot) and refilled to the proper level.

After 500 Miles

After the first 500 miles the crankcase oil should be selected to give the best performance for the climatic and driving conditions under which the truck is being operated.

Climatic Conditions

During the colder months of the year, an oil which will permit easy starting at the lowest atmospheric temperature likely to be encountered should be used.

When the crankcase is drained and refilled, the crankcase oil should be selected not on the basis of the existing temperature at the time of the change, but on the lowest temperature anticipated for the period during which the oil is to be used.

If oil is selected for existing temperatures, starting trouble may be encountered due to slower cranking speeds caused by too heavy an oil.

The viscosity grade of crankcase oil will, therefore, depend upon the climatic conditions under which the truck is operated.

Fall — Winter — Spring

The viscosity grade best suited for use in the engine at the various temperatures is given under reference Note 5 at the end of this section. Use the grade indicated for the lowest temperature expected. Always use the lighter grade oil when in doubt.

10-W oil plus 10% kerosene is recommended only for those territories where the temperature falls below 10 degrees below zero for protracted periods.

Summer

The use of 20-W or SAE 20 oils during the summer months will permit better all around performance than will the heavier body oils, with no appreciable increase in oil consumption.

If SAE 20 or 20-W oil is not available, SAE 30 oil may be used if it is expected that the average prevailing daylight temperature will consistently be above 90° F.

Maintaining Oil Level

The Oil Gauge Rod (Fig. 1) is marked "Full" or "Add Oil." These notations have broad arrows pointing to the level lines.

The oil level should be maintained between the two lines; neither going above the "Full" line nor under the "Add Oil" line.

Check the oil level frequently and add oil when necessary. Always be sure the crankcase is full before starting on a long drive.

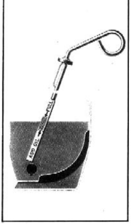

Fig. 1—Oil Gauge Rod

When to Change Crankcase Oil

Some oils have been greatly improved, driving conditions have changed, and improvements in en-

Section 1

BODY

TRUCK CAB ATTACHMENT TO FRAME

The Chevrolet truck cab is all-steel construction with mountings that provide a secure, yet flexible, attachment to the chassis frame.

The cab mounting of the 1½-ton truck is illustrated in Fig. 1. The mounting consists of four through-bolts on each side with fabric rubber insulation between the cab sill and the top of the frame side member to absorb shock. In order to prevent wrenching of the cab as the truck moves over uneven terrain or road, the two rear mounting bolts on each side of the cab are spring-loaded, as shown in Fig. 1. The cab is further insulated at each rear mounting bolt by a hard rubber bumper encased in a metal retainer. The mounting bolt passes through the center of the rubber bumper and retainer, and a heavy cushioning coil spring is placed between the bolt head and cab sill. The lower end of the bolt passes through the top channel of the frame side rail and terminates in a castellated nut, locked with a cotter pin.

The position of the rear center cab mounting bolt is reversed from that of the rear bolt in that the cushioning spring is placed below the top channel of the frame side rail and between it and the castellated retaining nut. The other two mounting bolts are not spring-cushioned but fabric rubber insulators are used between the cab sill and frame upper channel at each of these bolt positions.

The cushion spring method of mounting is designed to permit the truck frame to weave under certain conditions without placing undue strain on the cab structure. The cushion mounting bolt retaining nuts should only be tightened to a point where it is most possible to insert the cotter pin and no further. Greater tightening would compress the springs to such an extent that flexibility would be destroyed.

Door Glass

A metal frame is mounted on the door glass with the conventional rubber filler strip; this frame reinforces the glass and at the same time provides freedom from looseness and rattles. Procedure for installation of a door glass is as follows:

1. Remove door lock handle, window regulator and remote control handles.
2. Remove the door inner panel screws and remove the panel.
3. Remove the screws which mount the regulator board, and tip the regulator board away from the door. This disengages the regulator from the cam channel, as shown in Fig. 4.
4. Raise the glass and remove the glass run channel from its retainers on the lock pillar side, then remove the glass.
5. To install the metal channels, place a length of rubber filler strip over the edge of the glass, then

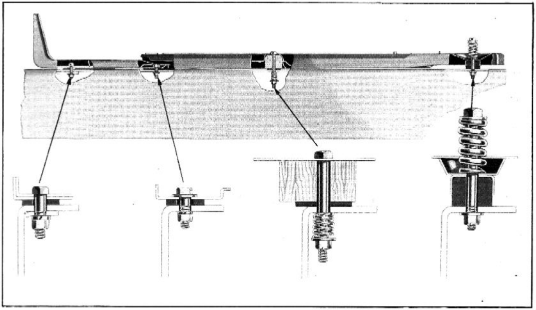

Fig. 1—Truck Cab Mounting

tap the channel over the glass and filler strip; trim the filler flush with the channel using a sharp knife or safety razor blade.

6. Install the glass in the door opening, lubricate the cam channel with graphite grease, connect the regulator to the cam channel, as shown in Fig. 2. Reassemble the regulator board, door inner panel, and control handles.

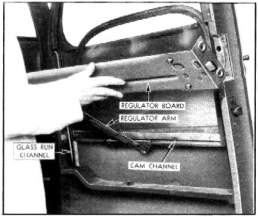

Fig. 2—Removing Window Regulator

When the door glass is removed, a glass run channel may be replaced by removing the garnish moulding and then removing the screw which anchors the top of the channel.

Door Lock and Window Regulator

A door lock or window regulator may be easily replaced when the regulator board is removed from the door, as they are mounted on the regulator board by screws.

Windshield Glass Replacement

1. Release the center lock and remove the quadrant adjusting screws.
2. Remove the two screws and sleeve nuts from each windshield hinge.
3. Remove the three screws from the top and bottom reinforcing plates, then remove the four screws from the center division channel and remove the inner and outer channels with their seals.
4. Remove the screws which attach the top and bottom channels to the frame reinforcement on one side of the center division channel. Then pull the two halves of the windshield apart at the center, as shown in Fig. 3.
5. When replacing a windshield glass, place a strip of Everseal filler channel over the edge of the glass, with the soap-stoned side out. Brush the inside of the windshield channel with light lubricant oil. Push the glass with the channel filler into the windshield channel by hand.

   NOTE—The oil acts on the channel filler, causing it to swell, thereby making a perfect watertight seal.
6. Assemble the windshield halves and install the screws in the center reinforcement.
7. Coat the center division seal with FS-638 sealing compound and install it between the two glasses, then coat the inner seal with sealing compound; install the inner plate, tightening the screws securely.
8. Install the top and bottom reinforcing plates, and reassemble the windshield in its opening.

Windshield Weatherstrip

The rubber weatherstrip which surrounds the windshield frame fits into a groove around the outside of the windshield frame. To remove the weatherstrip, just pull it out of the groove. When installing a new weatherstrip, place the outside edge into the groove and push the inside edge into place using a putty knife.

Windshield Wiper

The windshield wiper motors are located in the header panel. Removing the small plate attached to the header panel by four screws exposes the motor and vacuum line connections for service. The motor may be removed by disconnecting the wiper blade and removing the mounting nut on the front of the header panel.

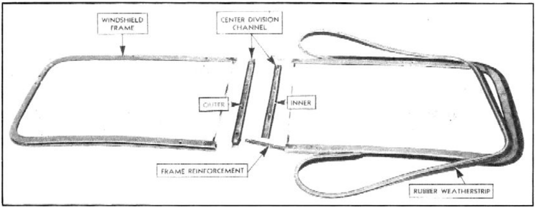

Fig. 3—Showing Windshield Split at Center Reinforcement

Section 2
FRAME

½ Ton Truck

The ½ ton truck frame is a five cross member frame with a flat kick-up over the rear axle. At the rear of the kick-up, the side members continue at the same level as the portion ahead of the kick-up. This provides a very satisfactory surface upon which to mount bodies. The cross members are very rigid being of a flanged "U" and box section construction.

The engine rear support is a flanged inverted "U" member. This member is secured to the side members by means of a construction known as "alligator jaw" attachment.

The second cross member is of box member construction for its entire width. Bolt attachment to the side members provides easy removal for the servicing of the transmission.

The third cross member, also a flanged inverted "U" section, supports the hand brake cable pulleys and the pulley bracket forms a box section with the cross member.

A single rear cross member is used. This member is formed upward at the center for spare wheel mounting.

¾ Ton Truck

The ¾ ton truck frame incorporates in its design many of the construction features of the ½ and 1½ ton truck frames.

The frame tapers from the front end to the second cross member, beyond which it forms a straight section. This arrangement supplies an excellent mounting for the bodies, as the straight section extends under the entire length of the load platform.

The side members are formed in a deep channel section from thick sheets of steel. The top flange is uniform in width over its entire length, but the lower flange is wider for a short distance at the front and rear to provide greater strength for the attachment of the cross members. Each side member is reinforced at the rear hanger of the front spring by a special channel. There is a small kick-up over the rear axle for clearance.

Cross members are of the flanged "U" and box-section construction—the type of design most suitable for truck service. Since the front end is similar to the ½ ton design, the rugged front cross member and engine rear support member of

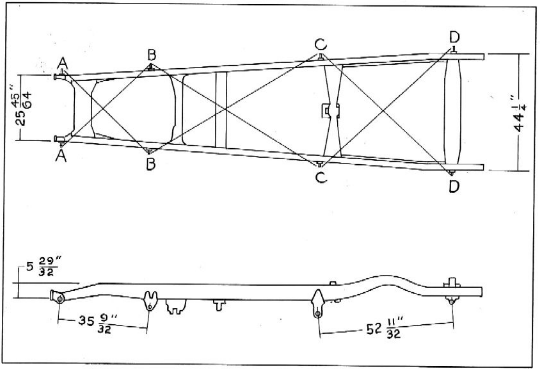

Fig. 1—½ Ton Truck Frame

that frame are utilized in this unit. In addition to supporting the rear of the power plant, the rear support also functions as a cross member.

The second cross member of box-section construction is identical to the ½ ton member, including the holes at the center section for attaching the universal joint support bracket. The plate of this support doubly ties together the flanges of the cross member in a reinforced box section, greatly increasing its strength over the entire center section. The side members and rear universal joint support are bolted to this cross member so that the transmission can be removed for servicing without disturbing the rear axle.

The third cross member is similar in design to the corresponding member in the ½ ton frame. It is of the inverted flange "U" type with alligator jaw attachment to the side members.

The rear cross member is identical to the one on the 1½ ton frame. It is a strong panel rigidly riveted at each end to the flanges of the side members. This member continues to be located at the rear bracket of the rear spring, and in addition to being riveted to the lower flanges of the side members, it is reinforced at each end by a gusset that joins the upper flange of the member and side member in a sturdy connection. The gusset is the same part as used on the 1½ ton truck.

134½" W.B. 1½ Ton Trucks

The 134½" wheelbase 1½ ton truck frame has five cross members. It is similar to the ¾ ton truck frame with exception to a slight difference in the brake cross shaft bracket.

1½ Ton 160" W.B. Trucks

Six cross members are used on the 160" wheelbase 1½ ton truck. Its frame is similar in construction to the ¾ ton truck frame with exception to a slight difference in the brake cross shaft bracket.

STRAIGHTENING THE FRAME

In the case of a collision or accident where the bending or twisting of the frame is not excessive, it is permissible to straighten the frame. This must be done cold, as heat applied to the frame will change the structure of the metal and weaken the frame at the point where heat is applied.

Checking Frame Alignment

When checking a frame for misalignment in case of damage, the most efficient method is "X" checking with a tram from given points on each side rail.

In the Figures 1, 2 and 3, reference points are indicated—"A," "B," "C" and "D" on each frame side member.

When making checks, the tram points should be set at the center of the lubrication fittings.

When "X" checking any section of the frame, the measurements should agree within 5/16". If the measurements do not agree within the above limit, it means that corrections will have to be made between those measurement points that are not equal.

The minimum dimensions between the spring hangers both front and rear are also shown on the illustrations. In addition the height of the front spring horns with reference to the top of the frame side member is shown.

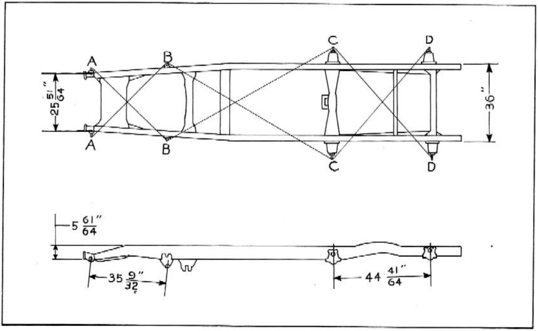

Fig. 2—¾ Ton Truck Frame

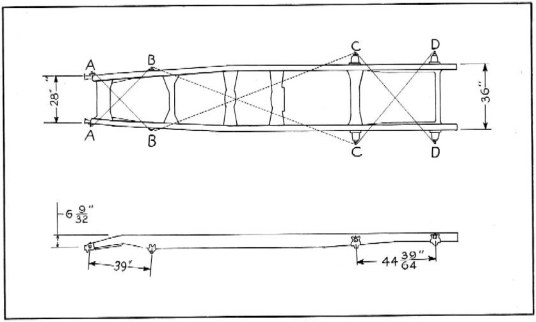

Fig. 3—1½ Ton Truck Frame

SHOCK ABSORBERS

Shock absorbers provide a smoother ride for the occupants by dampening the spring vibrations as the truck passes over irregularities in the road. There are two types of shock absorbers: single-acting, and double-acting. The single-acting shock absorbers control the speed of REBOUND of the truck springs. Double-acting shock absorbers control the speed of both REBOUND and COMPRESSION of the truck springs.

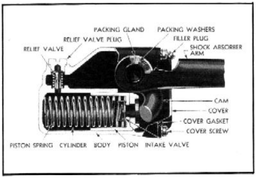

Fig. 4—Single-Acting Shock Absorber

OPERATION OF SINGLE-ACTING SHOCK ABSORBERS

The construction of the single-acting shock absorber is shown in the cross section view, Fig. 4.

When the wheels strike a bump, the car springs compress and the car frame moves downward, carrying the shock absorber with it. This causes the shock absorber arm to move upward, relieving the cam pressure on the piston. Relieving this pressure allows the piston spring to force the piston outward, creating a vacuum behind the piston. The vacuum causes the intake valve under the head of the piston to open, permitting the fluid to flow under the piston head and fill the piston chamber, Fig. 5.

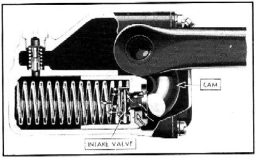

Fig. 5—Shock Absorber Action When Car Strikes a Bump

As the wheels pass over the bump, the car springs rebound and the car frame moves upward, carrying the shock absorber with it. This causes the shock absorber arm to move downward, applying cam pressure on the piston. The cam forces the piston into the cylinder, closing the intake valve. The oil, trapped in the cylinder, forces the relief valve off its seat and passes slowly into the reservoir. This action, Fig. 6, slows up the rebound of the truck springs.

The type of single acting shock absorber shown in Fig. 4, with a separately mounted intake valve and relief valve, is used on the front and rear of

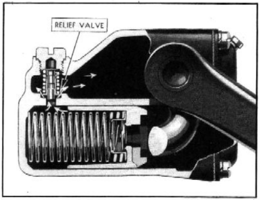

Fig. 6—Shock Absorber Action in Controlling Rebound of Car Spring

the ½ and ¾ ton trucks to control the rebound of the springs.

OPERATION OF DOUBLE-ACTING SHOCK ABSORBERS

Reservoir Type

This type of shock absorber, available on all trucks, has both pistons contained in one housing. A cross section view of the double-acting shock absorber is shown in Fig. 7.

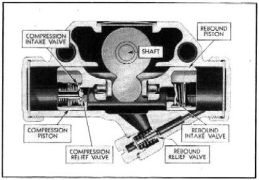

Fig. 7—Front Shock Absorber

During truck spring compression, fluid flows from the compression cylinder, through the relief valve, into the reservoir, and thus dampens the spring compression. At the same time, fluid enters the rebound cylinder through the intake valve. This action is shown in Fig. 8.

During truck spring rebound, fluid flows from the rebound cylinder, through the relief valve, into the reservoir, thereby dampening the spring rebound. At the same time, fluid flows into the compression cylinder through the intake valve. This sequence of events may be followed by referring to Fig. 9.

The cross-section views shown, Figs. 7, 8, 9, illustrate the type of shock absorber used at the front of the truck, but the operating principles of the rear shock absorbers are quite similar, the exception being

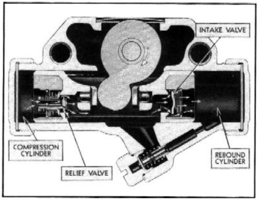

Fig. 8—Action During Spring Compression

that the compression valve is not located in the compression piston. A separate passage is provided in the rear shock absorber housing for the compression valve and a cap retains the compression valve in

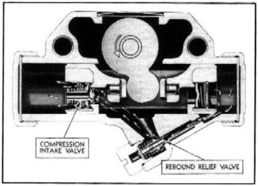

Fig. 9—Action During Spring Rebound

position the same as for the rebound valve. While the compression and rebound valves of the rear shock absorbers are identical with those of the front, the design of the rear shock absorbers differs slightly to allow for increased load distribution at the rear of the unit.

Valve markings are located on the valve caps or in the case of the compression valve on the front shock absorbers, on the end of the compression piston cover.

GENERAL SERVICE INSTRUCTIONS

Before proceeding with any repair operations on the shock absorbers, lubricate the truck springs and shackles and check the air pressure in the tires to see that it does not exceed the recommended pressure. In order to obtain a smooth ride, shackles must act freely and the tires must not be over-inflated.

After these preliminary operations have been completed, disconnect the link from the axle and pull the shock absorber arm down. If the arm comes down easily, part way, then comes to a stop

and moves down slowly the rest of the way, there is not enough fluid in the shock absorber.

Clean the shock absorber thoroughly, then remove the filler plug. With fluid injector, KMO-1026, fill the shock absorber with shock insulating fluid, to a level with the filler plug hole.

NOTE—This method of filling applies to all shock absorbers.

Replace the filler plug and move the arm up and down vigorously several times to work the oil into the piston cylinder.

After the arm has been moved up and down to fill the cylinder, insert additional fluid to fill the reservoir. Allow the fluid to escape down to the bottom edge of the filler plug hole before replacing the plug. This provides the necessary air space in the shock absorber.

Leaks at the cover or at the valve plug can be corrected by installing a new cover gasket or filler plug lead gasket washer.

On double-acting shock absorbers, leaks at the end caps, valve plug, or filler plug can be eliminated by installing new end cap fibre gaskets, or valve and filler plug lead gaskets.

Packing washers on shock absorbers which have been operating with oil below the proper level, are apt to become worn, causing oil leaks around the shaft. Such leaks can only be corrected by replacing the shock absorbers.

SERVICE OPERATIONS—SINGLE-ACTING SHOCK ABSORBERS

Disassembly

Remove the shock absorber from the truck and place in an assembly fixture as shown in Fig. 10.

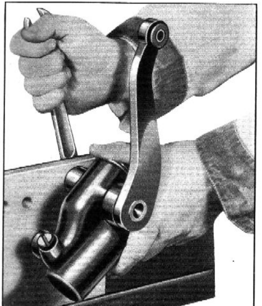

Fig. 10—Shock Absorber Holding Fixture

CAUTION—Do not clamp the shock absorber in a vise as pressure on the cylinder will bind the piston.

Remove the valve plug, relief valve, and cover from the shock absorber. Remove the piston, intake valve, and the piston spring. DO NOT attempt to remove the shock absorber arm, shaft, or cam, as these parts are assembled under 24,000 pounds pressure and are NOT to be removed.

If the bearings show excessive wear the shock absorber should be replaced.

Wash all parts in kerosene; inspect the piston, cylinder bore, valves, and springs before reassembling. Replace any worn or broken parts.

Reassembly

Assemble the intake valve onto the spring and place the piston over the spring and valve. Insert the assembly into the cylinder.

Push the piston into place and pull the shock absorber arm over until the cam holds the piston in the cylinder, then assemble the cover to the shock absorber, using a NEW gasket.

Fill the shock absorber with shock insulating fluid and install the relief valve and plug, using a NEW lead washer under the plug. Install the shock absorber on the truck.

SERVICE OPERATIONS—DOUBLE-ACTING SHOCK ABSORBERS

Reservoir Type—Disassembly

Remove the shock absorber from the truck and place it in the assembly fixture. Remove the filler plug and valve and drain the fluid from the shock absorber, working the arm back and forth until completely drained. Remove both end caps, using special serrated wrench, J-766, Fig. 11.

Remove the valve retaining snap rings and valves from both pistons. Clean and inspect all parts.

Reassembly

Install valves and snap ring, using special tool, J-896-A, Fig. 12.

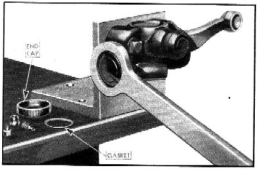

Fig. 11—Removing End Caps from Double-Acting Shock Absorbers

CAUTION—Be sure to install the inlet valve in the piston, located at the same end as the separately mounted relief valve.

The open side of the snap ring should be installed as shown in Fig. 13. If it is installed in any other position it is very difficult to remove.

After the valves have been installed, flip the valve with a screwdriver to make sure that the valve and spring are free.

Reassemble the end caps, using NEW lead gaskets under the plugs.

Fill the shock absorber with shock insulating fluid. Install the filler plug and move the arm up and down vigorously several times to insure filling the

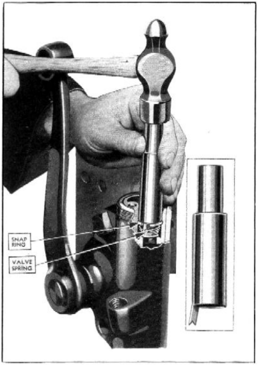

Fig. 12—Installing Valve and Snap Ring

cylinders. Remove the filler plug and add fluid to a level with the bottom edge of the filler plug hole. Install the filler plug, using a NEW lead gasket.

SERVICING SHOCK ABSORBER LINKS

Unsatisfactory shock absorber action and shock absorber noise are usually due to worn links, link bushings, and grommets. To determine if one or more of these conditions exist, disconnect the link from the axle and check for lost motion at both ends. If wear has occurred, replace the grommets and bushings at both ends, in the following manner.

Remove the shock absorber from the truck and disconnect the link. Press the worn bushings and grommet from the shock absorber arm, using the bushing remover and support, J 903, in an arbor press, as shown in Fig. 14.

Coat a new rubber grommet with liquid soap, for easy installation, and press it into the shock

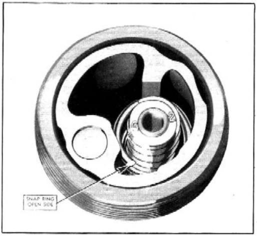

Fig. 13—Correct Position of Snap Ring

absorber arm, using tool, J-901, to insure proper seating of the grommet.

Place a new bronze bushing on the pilot of the bushing replacer and press the bushing into the grommet, Fig. 15. The replacing tool, J-899, expands the grommet and should be used for this operation to prevent damaging the grommet.

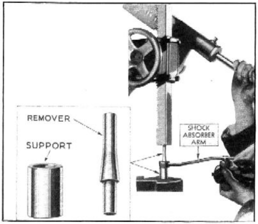

Fig. 14—Removing Bushing and Grommet from Shock Absorber Arms

The pin holes at the ends of the link are of different diameters and the knurled end of the pin should be inserted through the large hole.

Press the pin into the link, using tool, J-902. This tool limits the depth that the pin can be pressed through the link, preventing damage to the link holes.

After the pin is installed, strike the link against the press plate of the arbor press. A sharp blow on the head of the pin will properly seat the large hole on the shoulder of the pin.

Assemble cotter pins to the link pins and install the shock absorber on the truck.

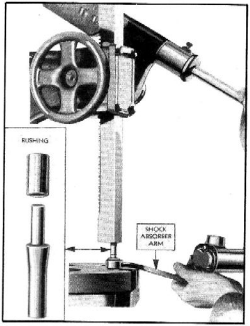

Fig. 15—Installing Bronze Bushing in the Grommet in the Shock Absorber Arm

TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling shock absorbers:

Tool Number	Description
KMO-1026	Fluid Gun
J-766	Knurled End Cap Wrench
J-896-A	Valve Installing Tool
J-899	Link Bushing Driver, Small
J-902	Link Pin Setting Tool
J-901	Rubber Bushing Depth Spacer
J-903	Link Bushing Remover Support

SHOCK ABSORBER SPECIFICATIONS

	½ and ¾ Ton	½-Ton	¾-Ton
	Front	Rear	Rear
Model Number	1430CA-DA	1430LA-MA	1431X-Y
Type	Reservoir	Reservoir	Reservoir
Make	Delco-Hydraulic	Delco-Hydraulic	Delco-Hydraulic
Action	Single	Single	Single
Valve Markings: Rebound Compression	4CG —	3CG —	3CG —

	½, All ¾ and 1½-Ton	½-Ton	All ¾-Ton	1½-Ton
	Front	Rear	Rear	Rear
Model Number	1731-C-D	1731-T-U	1732-N-P	2000-V-W
Type	Reservoir	Reservoir	Reservoir	Reservoir
Make	Delco-Hydraulic	Delco-Hydraulic	Delco-Hydraulic	Delco-Hydraulic
Action	Double	Double	Double	Double
Valve Markings: Rebound Compression	2-J G-2	2-G G-2	1-J G-0	1-J G-0

Section 3

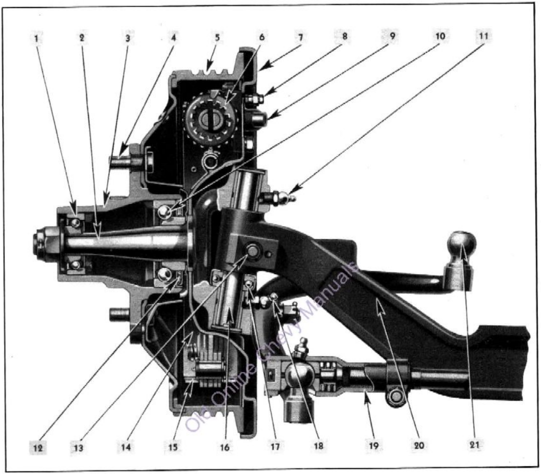

Fig. 1—Front Axle Assembly—½, ¾, 1½-Ton Trucks

1—Outer Wheel Bearing
2—Wheel Spindle
3—Wheel Hub
4—Wheel Hub Bolt
5—Brake Drum
6—Brake Wheel Cylinder
7—Brake Flange Plate
8—Brake Bleeder Valve and Screw
9—Brake Wheel Cylinder Hose Connection
10—Inner Wheel Bearing
11—Lubrication Fitting
12—Inner Bearing Oil Seal
13—Kingpin Lock Pin
14—Brake Shoe
15—Brake Lining
16—Kingpin
17—Kingpin Thrust Bearing
18—Lubrication Fitting
19—Tie Rod End
20—Axle I-Beam
21—Steering and Third Arm

FRONT AXLE

½, ¾ AND 1½-TON TRUCKS

CONSTRUCTION

The front axle used in the ½, ¾ and 1½-ton trucks is known as the reverse Elliot type. It is a steel dropforging with the spring seats forged integral with the "I" beam. The "I" beam is heat-treated for extreme toughness and is machined to very close limits.

The kingpin is recessed and held in position by a tapered pin drawn tightly into the recess by a lock washer and nut. The holes at each end of the "I" beam are bored at a slight angle to permit the kingpin to tilt inward at the top. This inward tilt is called kingpin inclination.

The steering knuckle is mounted to the front axle by means of this kingpin, and rides on a ball bearing which makes steering easy.

The brake flange plate is securely bolted to the steering knuckle and carries the brake shoes and

wheel cylinders. The steering knuckle arms are also bolted to the steering knuckle and are connected with each other by the tie rod. The tie rod is the adjustable type attached to the knuckle arms and controls the amount of toe-in of the front wheels.

The third arm is forged integral with the left knuckle arm and is connected to the pitman arm by the steering connecting rod.

A caster shim or "I" beam spacer is inserted between the front springs and the front axle. The installation of this shim controls the amount the top of the axle inclines or tilts backward. This backward tilt of the axle gives the front wheels their caster.

The front wheel spindles, forged integral with the steering knuckles, are tilted downward at their outer ends, causing the front wheels to be farther apart at the top than they are at the bottom. This position of the front wheels is called camber.

The steering knuckle arms are installed on the knuckles at an angle, permitting the front wheels to toe-out when making turns. This is necessary so that when turning curves, each wheel may travel in a different arc. This toe-out on curves is known as steering geometry.

These five front end factors are built into the axle and must be in proper relation to each other to prevent steering faults and excessive tire wear.

CASTER

Caster is the amount in degrees of the backward tilt of the axle and kingpin. See Fig. 2.

A truck without caster would lack steering stability, would tend to wander over the road and would be difficult to straighten out at the end of a curve or turn.

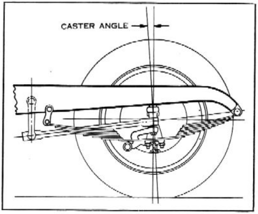

Fig. 2—Caster Angle

Unequal caster shows itself in the tendency of the truck to pull to the right or left. This condition comes about through the axle having been twisted so that there is a greater amount of caster in one kingpin than in the other. The direction in which the truck will tend to pull is towards the side with less caster. Suppose that an accident has put a twist into the front axle so that the left side is zero caster, while the right side is castered backward five or six degrees, the right wheel will have a strong tendency to turn inward, pulling the truck to the left.

CAMBER

Camber is the amount in inches or degrees that the front wheels are tilted outward at the top. See Fig. 3.

When a wheel has *too much camber*, or the wheel is tilted too far out at the top, the tire is forced by road contact into a conical shape, on its under side. The result would be excessive tire wear on the outer edges of the tread.

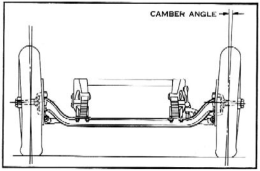

Fig. 3—Camber Angle

Reverse camber, or a wheel that is tilted too far in at the top, would result in excessive tire wear on the inner edges of the tread. The center of the tread would remain comparatively unworn.

The rule is that if wheels have the maximum of allowable camber they must have the maximum of allowable toe-in. If wheels have the minimum amount of allowable camber they must have the minimum amount of allowable toe-in.

Kingpin inclination is the amount in degrees that the tops of the kingpins are inclined toward the center of the truck. See Fig. 4.

Kingpin inclination tends to keep the wheel spindles pointed outward, in line with the axle,

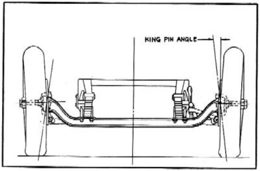

Fig. 4—Kingpin Inclination

just as caster tends to keep the wheels of an automobile pointed straight ahead. The effect is the same, since if the spindles are kept pointing out at right angles of the truck, the wheels will, as a result be kept pointing ahead. It makes the truck steer easier.

We have already referred to the close relationship between the factors that enter into the front axle assembly. It is a point that cannot be overstressed. One must keep this close interrelation constantly in mind to gain a full and true understanding of this cleverly designed mechanism. In order to correct any wrong adjustment, it is necessary to realize what effect a change in one element of the mechanism may have on the operation of the other parts.

TOE-IN

Toe-in is the amount in inches that the wheels toe-in, that is, the distance between the wheels at the front "A," is less than it is at the rear "B." See Fig. 5.

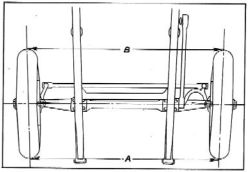

Fig. 5—Toe-In

Cambering the wheels out at the top makes it necessary to draw them in at the front.

Toe-in is a necessity growing out of camber and directly related to it. It might seem that since the wheels are headed inward toward the center of the road, while actually traveling a parallel course, there must be a constant grinding of their surfaces on the road surface. As a matter of fact, it is to avoid this tire-wearing surface grind that toe-in is employed.

Just as the purpose of camber is to give the wheel a setting so it will be in nearly a balanced free-running position as possible, so with toe-in, the purpose is to set the wheel in a position to reduce to a minimum the road friction on the tire.

STEERING GEOMETRY

Steering geometry is the mechanics of keeping the front wheels in proper relative alignment as the wheels are turned left or right. Fig. 6.

The front wheels, when the truck is making a turn, are not on the same radius line, drawn from the center around which the truck is turning, and because of this, it is necessary for the front wheels to assume a toed-out position when rounding curves. This position is governed by the angle of the steering arms.

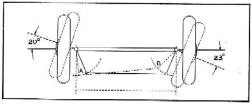

Fig. 6—Steering Geometry

The accuracy of the steering geometry is governed by the condition of the steering arms. For example, suppose a steering arm has been bent by bumping against a curb in such a way as to cause the right wheel to toe-in excessively when the car was turned around a corner. This tire would drag, causing rapid wear of that tire. The condition accounts for the cars and trucks we see once in a while that wear out one front tire twice as fast as the other, although, by usual tests, it is perfectly set for straight ahead driving.

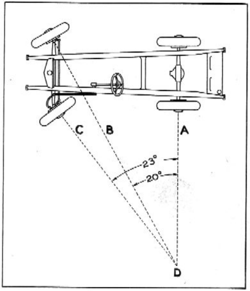

Fig. 7—Toe-Out on Curves

The wheel of any vehicle, if properly set on the curves, will be at a right angle to the radius line from the center or point around which the vehicle is turning.

Fig. 7 is a diagram of a truck making a left turn. The right wheel is set at an angle of twenty degrees —the angle being exaggerated to bring out the principles more clearly. A line "A" drawn through the rear axle and both rear wheels and a line "B"

drawn through the spindle of the right wheel meet at "D," which is the center around which the car is turning. Therefore, the left or inside wheel must be at right angles to the radius line "C" which passes through the spindle and strikes the lines from the other three wheels at "D."

REPAIR OPERATIONS

When service men thoroughly understand the foregoing, they will appreciate the accuracy necessary when checking the front end system. There are several different kinds of equipment, by which these operations can be performed.

It must be remembered that no matter what kind of equipment is used, that all of these checks must be made with the truck level, with the weight of the truck on the wheels and with no pay load.

Bad steering performance may be due to some cause not connected with front wheel alignment. Therefore, check to see that none of the following conditions are present before placing the car on the front end machine:

1. Loose or improperly adjusted steering gear.
2. Steering housing loose at frame.
3. Play or excessive wear in kingpins or bushings.
4. Loose tie rod or steering connections.
5. Loose spring shackles.
6. Loose front spring "U" bolts.
7. Front spring slipped on spring seat due to sheared center bolt.
8. Over-lubricated front springs.
9. Sagging or broken front springs.
10. Under-inflated tires.
11. Unbalanced or improperly mounted tires.
12. Motor mountings improperly adjusted.
13. Broken motor mountings.
14. Motor not properly tuned, rough or "missing."
15. Brakes dragging.
16. Hub bolt nuts loose.
17. Shock absorbers not operating properly, low on fluid or dry.

After this inspection is completed and the conditions corrected, the truck should be placed on the front end machine and checked. There are several types of front end machines on the market using different mechanical means for locating and correcting front end troubles. The instructions furnished by each manufacturer for the operation of his particular machine should be followed.

STRAIGHTENING FRONT AXLE "I" BEAM

When it is necessary to straighten the front axle "I" beam out of the truck, the gauge J-1185 illustrated in Fig. 8, should be used. The gauge consists of two pins that fit in the kingpin holes. These pins are tapered so that they properly fit and center in the axle.

The first operation in straightening "I" beams, is to properly level the spring seats either on an arbor press or with a bending bar. Assemble the kingpin pins into the holes in the end of the beam. Place a cord on each pin and slide a square on the spring seat until it touches the cord. Check from the square to center of the spring tie bolt hole.

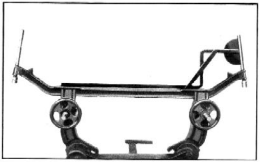

Fig. 8—Front Axle "I" Beam Gauge

When the axle is in proper alignment the kingpin holes and the hole for the spring tie bolt holes in the spring seats, are all in line.

Place the gauge on the spring seats and check the angle of the pins against the face of the gauge. When the kingpin angle is correct, the pins will be parallel with the face of the gauge.

CAUTION—Do not heat Chevrolet front axle "I" beams to straighten. Straighten them cold—heating will change the metal strength.

FRONT WHEELS

Remove and Replace

Lift the wheel from the ground with a jack under the front axle "I" beam. Remove hub cap. Pull out cotter pin locking the spindle nut. Remove the spindle nut and spindle washer. Remove front wheel.

The outer cone and balls and the inner cone are loose and may be easily removed. The inner balls may be removed by prying out the inner bearing felt retainer. If this is done, a new felt retainer assembly should be used when reassembling. The ball cups are pressed into the hubs and can be driven out by inserting a bar through the hub so that one end rests against the cup. By tapping lightly at several points around the circumference of the cup, through notches in shoulder inside of hub, it can be removed without damage. It is well to remember that the cups are very hard, therefore, extreme care should be used in removing not to crack them.

In replacing the cups, be sure that they are pressed into the hubs evenly and as far as they will go, that is, that their backs are against the shoulder in the bottom of the hole.

Before installing the separator and ball assemblies in the hub they should be packed with Marfak lubricant or its equivalent, using No. 2 in summer and No. 1 in winter.

When replacing the front wheel be sure the inner oil deflector is in its proper place between the inner bearing cone and the shoulder on the knuckle spindle. As the wheel is pushed onto the spindle it should be made certain that the inner oil deflector has passed inside of the outer oil deflector.

Be sure that the nuts which hold the wheel to the wheel hub are put on with the taper side to the wheel hub.

Adjustment

After the wheel has been replaced on the steering knuckle spindle, with the bearings and felt retainer in their proper location, install the spindle washer against the cone of the outer bearing then adjust the bearings as follows:—

1. Using an 8" wrench (never larger) and applying a steady force with one hand, pull up the adjusting nut until the wheel is somewhat hard to turn by hand. At the same time rotate the wheel to be sure that all parts are correctly seated.
2. Back off the adjusting nut one-half castellation or one-twelfth turn.
3. If the slot in the nut and the cotter pin hole line up, insert the cotter pin. If not, back the nut off until the slot and the hole are in line and then insert the cotter pin.

NOTE—In order to provide for close bearing adjustment, the cotter pin hole is drilled in the spindle in both the vertical and horizontal plane.

With the bearing inner cup an easy-push fit in the hub and the nut a free-running fit on the spindle threads, this will give an adjustment toward the tight side, which will allow for settling and working-in of the parts in service.

Front wheel bearings should never be set up on the loose side, as such an adjustment does not bring the balls and races into proper contact.

It is well to note that the slight friction of a new snugly fitting felt retainer assembly will temporarily produce a slight drag on the wheel, but this is easily recognized and should not be confused with adjustment of the bearing. Spin the wheel, making sure that all parts are in correct position, then clinch cotter pin securely.

FRONT AXLE TIE ROD

The front axle tie rod is of the ball, seat and spring type, similar to the steering connecting rod construction.

Refer to Fig. 9, and note how parts are assembled. The parts on both ends are assembled in the same manner. First the spring seat, then the spring and ball seat, then the ball and ball seat, and then the plug. Ball seats should be assembled so that notches line up with ball neck.

To properly adjust the front axle tie rod:

1. Remove cotter pins.
2. Screw plugs in tight until springs are compressed solid and back off to first cotter pin hole.
3. Insert and clinch cotter pins.
4. Lubricate both ends of tie rod.

To remove the tie rod from the front axle, remove the cotter pin, end plug and ball seat. Screw end plug back into the end of the tie rod until the ball is in the center of the opening. A light tap with a soft hammer will remove the tie rod from the ball.

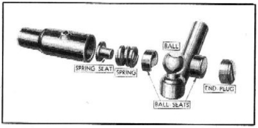

Fig. 9—Front Axle Tie Rod

Toe-In Adjustment

Front wheel toe-in can be adjusted by loosening the clamp bolts at each end of the tie rod and turning the tie rod to increase or decrease its length until a toe-in of 5/64" to 1/8" is secured, then tighten the clamp bolts securely.

½-TON PANEL TRUCK STABILIZER

A ride stabilizer is used at the front of the ½-Ton Panel Truck to prevent excessive side sway on turns.

To remove the stabilizer from the truck, first remove the spring "U" bolts attaching it to the top of the spring and then remove the large bolt at the upper end of the two-piece bracket which extends through the bracket, spacer, and frame side rail. The stabilizer assembly can then be removed. To remove the bracket from the bar it is necessary to remove the bolts holding the two-piece bracket together so as to relieve the pressure on the rubber bushings. The bracket and bushing can then be slipped off over the end of the bar.

Replacing the stabilizer on the truck is the reverse of the above, except that the bolts which clamp the two parts of the bracket together should not be tightened until after the stabilizer is in place on the truck, and the weight of the truck with no pay load on its wheels. This is important so that the rubber bushings will grip the bar in proper relation to the frame and axle, and prevent excessive up and down movement of one front wheel relative to the other.

CAUTION—Do not attempt to adjust the stabilizer by tightening the bolts in the bracket when there is a load in the truck. This would destroy its effectiveness.

All commercial frame front cross members are punched for the adaptation of this assembly if desired.

KINGPIN

Remove and Replace

To remove and replace the kingpin, jack up the front of the truck and remove the front wheel. Remove the nuts which attach the brake flange plate to the steering knuckle. Remove the brake flange plate. Remove the top kingpin bearing plug. This can be done with a sharp prick punch. Remove the kingpin lock pin.

Drive the kingpin down and out of the bottom with a brass rod. This removes the bottom plug and the kingpin.

In replacing the kingpin the operations are just the reverse of the above removal operations, except that you should always use new kingpin bearing plugs and new lockwashers, and clinch over all cotter pins securely.

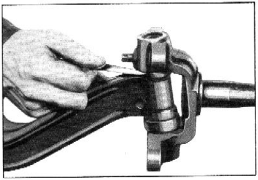

Fig. 10—Clearance Between Steering Knuckle and "I" Beam

The kingpin bearing plugs on all trucks have no "expansion" feature, and must be staked in place by peening or staking over the ends of the steering knuckle to hold the plugs securely in place.

Drive in the kingpin with a soft head hammer. After the kingpin is installed with the thrust bearing assembled at the bottom of the kingpin with the dust shield side at the top, check the clearance between the steering knuckle and axle "I" beam. See Fig. 10. If this clearance is more than .006″ install a steel shim between the steering knuckle and the "I" beam at the top of the kingpin.

In installing this shim, start the kingpin in at the top of the knuckle and place the shim over the kingpin. Mount the knuckle over the end of the "I" beam and drive the kingpin part way through the "I" beam. Insert bearing between the "I" beam and the knuckle and drive the kingpin into position.

Trucks that have been operated for a period of time with loose kingpin bushings, in many cases, tend to "bell mouth" the kingpin holes in the ends of the "I" beam. As a means of making a satisfactory repair and prevent future kingpin breakage due to the kingpins being loose in the "I" beam, .010″ and .020″ oversize kingpins and bushings are available for 1½-Ton Trucks.

Special reamers are available on the market for reaming the holes in the "I" beam ends for oversize kingpins.

KINGPIN FLOATING BUSHINGS

½ AND ¾-TON TRUCKS

On the ½ and ¾-ton trucks the kingpin bushings are bronze bushings of the "floating" type. When replacing these bushings it is not necessary to ream them to size, as service bushings are machined to finished dimensions. However, when replacing floating bushings care should be used to make sure that the oil groove in the bushing lines up with the lubrication fitting in the steering knuckle. These bushings should be free on the kingpin, but may be somewhat snug in the steering knuckle.

After the kingpin bushings have been installed, the front end alignment should be checked to make sure that all of the factors of front end alignment are within the specified limits.

REMOVE AND INSTALL STEERING KNUCKLE BUSHINGS, 1½-TON TRUCKS

A bushing puller should be used in removing steering knuckle bushings. If a tool of this kind is not available, an ordinary coarse threaded tap of

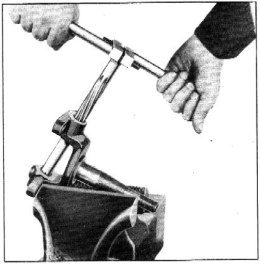

Fig. 11—Reaming Steering Knuckle Bushings

the proper size can be threaded into the bushing, and with a bar whose diameter is slightly less than the diameter of the hole and 1 inch longer than the distance through the steering knuckle, drive out the tap and bushing.

To install new bushing, round edges with a file; place in proper position with respect to knuckle to align oil holes, noting that the oil hole is nearer one end than the other. Press into place with a vise or arbor press, taking care to start bushing straight into the hole. Do not hammer on bushing or otherwise deform it.

After the bushings are in place, they should be carefully reamed to size, using a reamer long enough to reach through both bushings at once, or preferably a reamer having a long pilot bar which will just pass through the opposite bushing while one is

being reamed, the cutting flutes also being long enough to finish the bushings together. Fig. 11.

NOTE—When oversize kingpins are installed, it is necessary to ream the steering knuckle bushings first with the reamer used for fitting a standard size kingpin, and then with the special oversize reamer to fit the .010" or .020" oversize kingpin, to provide .002" clearance between the kingpin and bushing.

FRONT SPRINGS

½-TON TRUCK

The front springs on the ½-ton truck are flat under load, contributing to improved steering geometry by reducing to a minimum the fore and aft movement of the front axle and attaching parts. The rear eye of the front spring is of the "Berlin" type, meaning that the horizontal center is approximately level with the main leaf center.

¾-TON TRUCK

The front springs of the ¾-ton truck are "two-stage" type, or in other words the spring rate with the truck light is considerably lower than when loaded. The advantage of this type spring is that the rebound or "throw" is much less when the truck is light and the resistance to "bumping through" is greater when the truck is loaded. The change in spring rate from the low to the higher rate takes place at or near the rated load capacity of the truck.

1½-TON TRUCK

The front spring on the 1½-ton truck is a low camber spring of high load carrying capacity. The rear eye is also of the "Berlin" type, with a second leaf which partially wraps the main eye for additional safety.

Front spring data will be found under the heading "Spring Specifications" at the end of this section.

THREADED SHACKLE

A threaded type spring shackle is used at the front of the front spring on the ½, ¾ and 1½-ton truck models.

In this design threaded bushings are pressed into the spring hanger and into the eye of the spring. Threaded pins with tapered ends are screwed into the bushings with each end projecting the same distance. The shackles are plain, heavy gauge steel stampings with tapered holes which fit tightly on the tapered ends of the pins. A draw bolt, having a square shoulder under its rounded head, engages each outer shackle. A nut at the inner side of each inner shackle serves to draw both inner and outer shackle members up snugly on the pins. See Fig. 12.

The pins are drilled from their outer ends to the center where a cross hole connects it with the threaded portion. Lubrication fittings are assembled in the end of each central hole to provide for lubrication of the threads. Cork washers are assembled at each end between the shackle and the hanger and between the shackle and the spring, to retain the lubricant in the threaded portion.

In action, this shackle, being tight on the tapered pin end, oscillates the pin in the threaded portion. This design uses all of the relatively large threaded surface for a bearing, reducing wear to a minimum and insuring long bearing life to these members.

If it becomes necessary to remove these bushings from either the spring eye or the spring hanger, Tool No. J-553 is required. Remove the draw bolt and the shackles. Screw tapered pins from the bushing and thread the end of the tool into the bushing. Turning the pull nut with a wrench will remove the bushing.

To install a new bushing, insert the threaded end of the tool through the spring eye or spring hanger and screw on a new bushing, until it is centered up with the hole in the spring eye or spring hanger. Turning on the pull nut will press this bushing into place.

Inspect the pin that was removed from the bushing and if it is worn, replace. Screw it into the

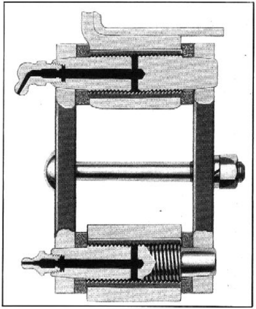

Fig. 12—Threaded Type Spring Shackle

bushing until each end projects 21/32" from the end of the bushing on either side. Place the four cork washers over the ends of the pins and assemble the shackle plates. Insert the draw bolt and draw the nut up snugly. Strike each end of each shackle a sharp blow with a hammer to insure seating of the tapers and retighten the shackle draw bolt.

Examine the lubrication fittings for damage, replacing when necessary and fill the pins completely full with chassis lubricant.

PLAIN BUSHING

A plain bushing type spring eye bolt is used at the rear of the front springs on the ½, ¾, and 1½-ton truck models. The construction and method of removing and replacing this type of eye bolt is the same as for the eye bolt in the plain bushed shackle, as described under "Rear Springs" in Section 4 of this Manual.

FRONT AXLE TROUBLES AND REMEDIES

Symptom	Probable Remedy
Hard Steering	
1. Lack of lubrication.	1. Lubricate the following points—tie rod ends, steering gear and steering connecting rod.
2. Tight steering gear.	2. Adjust steering gear according to instructions in Section 9 of this manual.
3. Improper toe-in.	3. Adjust toe-in.
4. Tires improperly inflated.	4. Inflate tires according to specifications given in Section 10 of this manual.
Front Wheel Shimmy	
1. Improper tire inflation.	1. Inflate tires to recommended pressure.
2. Wheels loose on hubs.	2. Tighten wheel hub bolts.
3. Improper toe-in.	3. Adjust toe-in.
4. Loose front wheel bearings.	4. Adjust front wheel bearings.
5. Steering knuckle bushings worn.	5. Replace bushings.
Wandering	
1. Tight steering gear.	1. Adjust steering gear.
2. Tires unevenly inflated.	2. Inflate tires.
3. Spring center bolt sheared and axle shifted.	3. Replace center bolt and relocate in spring seat.
4. Loose front wheel bearings.	4. Adjust front wheel bearings.
5. Improper toe-in.	5. Adjust toe-in.
6. Worn kingpin or steering knuckle bushings.	6. Replace worn parts.

TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling the Front Axle:

Tool Number	Description
J-1185	Axle Aligner Gauge
J-553	Shackle Bushing Tool
.923"	Steering Knuckle Bushing Reamer—1½-Ton Models

FRONT AXLE SPECIFICATIONS

	½ and ¾-Ton Trucks	1½-Ton Trucks
Caster—Degrees	1¾ ± ½	2¾ ± ½
Camber—Degrees	1 ± ½	1 ± ½
Kingpin Inclination Degrees	7° 10' ± 1°	7° 10' ± 1°
Toe-In—Inches	3/64 to 1/8	3/64 to 1/8
Steering Geometry (Toe-Out on Turns);		
Outside Wheel—Degrees	20	20
Inside Wheel—Degrees	23 ± 2	23 ± 2

KINGPIN DIAMETER

½ and ¾-Ton Trucks	.866" to .8665"
1½-Ton Trucks	.921" to .9214"

THRUST BEARING (KINGPIN)

½ and ¾-Ton Trucks	Matthews Mfg. Co., No. 8261-TA4
1½-Ton Trucks	Matthews Mfg. Co., No. 7801-TA2

WHEEL BEARINGS

½ and ¾-Ton Inner	
Inner Race	ND-909502
Separator and Balls	ND-909702
Outer Race	ND-909602
½ and ¾-Ton Outer	
Inner Race	ND-909501
Separator and Balls	ND-909701
Outer Race	ND-909601
1½-Ton Inner	
Inner Race	ND-909526
Separator and Balls	ND-909726
Outer Race	ND-909626
1½-Ton Outer	
Inner Race	ND-909525
Separator and Balls	ND-909725
Outer Race	ND-909625

SPRING SPECIFICATIONS

	½-Ton	¾-Ton	1½-Ton 134½ & 160"
Length	36"	36"	40"
Leaf Width	1¾"	1¾"	2"
Stage	Single	Two	Single
Rate—Lbs. per Inch	260	(275 / 365)	475
No. of Leaves	7	8	7
Leaf Thickness			
Nos. 1, 2	.237	.237	.297
No. 3	.237	.214	.297
Nos. 4, 5	.194	.214	.297
Nos. 6, 7	.194	.262	.297
No. 8	—	.262	—
No. 9	—	—	—
Total Thickness	1.487	1.902	2.037
Spring Clip Type			
No. 1	Clinch	Clinch	Bolt
No. 2		—	—
No. 3	Clinch	Bolt	Bolt
No. 4	Clinch	Clinch	Bolt

Section 4

REAR AXLE ASSEMBLY
½ AND ¾-TON TRUCKS

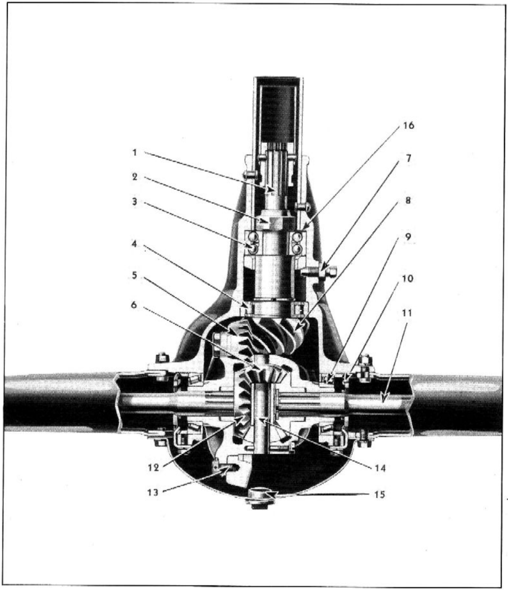

Fig. 1—Rear Axle Assembly ½-Ton Truck

1—Pinion Shaft
2—Pinion Bearing Retaining Nut
3—Front Pinion Bearing
4—Rear Pinion Bearing
5—Ring Gear
6—Differential Pinion Gear
7—Front Pinion Bearing Retaining Screw
8—Drive Pinion
9—Differential Side Bearing
10—Differential Side Bearing Adjusting Nut
11—Axle Shaft
12—Differential Side Gear
13—Ring Gear Cap Screw
14—Differential Pinion Gear Shaft
15—Filler Plug
16—Shims

The ½-ton truck rear axle is of the semi-floating type with Hypoid gears mounted in a one-piece banjo-type housing, Fig. 1.

The ½ and ¾-ton truck rear axles are similar in construction although the ½-ton is a torque tube drive (enclosed propeller shaft), while the ¾-ton is a Hotchkiss drive (open propeller shaft). The repair operations described in this section apply directly to the ½-ton truck; however, they also apply to the ¾-ton truck with the following exceptions.

The end of the differential carrier is machined to receive the spring loaded oil seal which engages the ground hub of the universal joint rear yoke. The pinion shaft is threaded at its forward end for the nut which attaches the universal joint rear yoke to the pinion shaft.

When assembling the pinion to the differential carrier, the universal joint rear yoke must be installed and its retaining nut tightened firmly before attempting to make any ring gear and pinion adjustment.

Instructions covering the repair of the ¾-ton front propeller shaft assembly will be found under the heading, "Front Propeller Shaft Assembly, ¾-Ton Trucks," page 4 - 16.

REPAIR OPERATIONS

In rear axle service work there are minor and major operations. Minor operations such as the removal of axle shafts, the replacement of brake drums, etc., can be performed with the axle under the car. Major operations, such as the replacement of ring gear and pinion, etc., must be performed with the axle out of the car, because it is impossible to obtain the correct pinion depth with the third member in the axle housing.

There are also two very important and essential points which all service men must keep in mind when working on rear axles. First—absolute cleanliness must be observed, and second—factory limits, clearances, and specifications must be maintained.

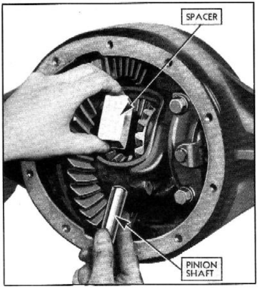

Fig. 2—Removing Axle Shaft Spacer

MINOR SERVICE OPERATIONS

To Remove and Replace Rear Wheel

Remove the hub cap by inserting a screwdriver between the inside edge of the hub cap and the wheel hub flange and turning the screwdriver until the cap becomes loose. Remove the hub nuts which are on the inside of the wheel hub. The wheel can now be lifted from the bolts which are attached to the axle shaft.

To replace the rear wheel, place it over the hub bolts and assemble the hub nuts with the tapered ends towards the inside of the hub. The tapered ends of these nuts must fit into the recesses provided for them in the wheel hub.

Remove and Replace Axle Shaft Assembly

Remove the wheel and tire assembly. Remove the two stamped brake drum retaining nuts (Zipon-type) from the two wheel, or hub, bolts.

Remove the brake drum from the axle shaft flange. Install wheel cylinder clamp on the brake wheel cylinder. Drain the lubricant from the differential and remove the housing cover.

Remove the differential pinion shaft lock screw, the differential pinion shaft and the axle shaft spacer. See Fig. 2.

Push the axle shafts in toward the center of the axle and remove the "C" washers from the inner ends of the axle shafts.

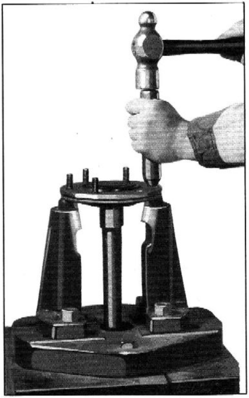

Fig. 3—Use of Peening Tool and Anvil

After this has been done, the axle shafts can be removed from the axle housing.

The wheel hub bolts are special serrated bolts pressed into the holes in the axle shaft flange, thus holding the bolts rigidly in place. These bolts are also used to hold the oil deflector and the gasket to the axle shaft flange.

When installing a new axle shaft, it is necessary to install new bolts, a new oil deflector, and a new gasket. Upon installing new hub bolts, the gasket between the deflector and the flange must be covered with a heavy shellac or paint on both sides to prevent oil leaks. The axle shafts have a hole through the flange which permits excess oil from the axle to drain out of the oil deflector, and keeps it out of the brake drum and brakes. The brake drums and gaskets have an extra hole, the center one of the three that are closest together should be lined up with the notch in the hub flange of the axle shaft. There is an oil pocket in the oil deflector which should also be in line with the notch in the hub.

When the axle shaft flange, the gasket, and the oil deflector are in line as mentioned above, insert the six special bolts and force the heads down to the deflector. The end of the shoulder on the bolts should then be peened into the countersink around the bolt holes in the flange, using the peening tool and anvil, J-554, shown in Fig. 3, thus riveting these parts securely together. It is good practice to turn the peening tool after each blow of the hammer to prevent damage to the tool.

CAUTION—This peening operation is very important from a safety standpoint.

It will be noticed that the axle shafts are of different lengths, the longer one being used on the right-hand side.

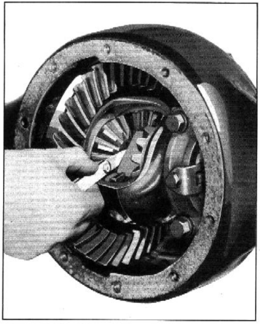

Fig. 4—Checking Clearance Between Axle Shaft and Spacer

Before replacing the axle shafts, examine the leather oil seal on the inside of the axle housing to be sure that it is not worn, damaged or out of place. Slide the axle shaft into place, being careful that the splines on the end of the shaft do not cut the leather oil seal, and that they engage with the splines of the differential gears. Replace the "C" washers on the inner end of the shaft and pry the shaft ends apart carefully (do not scratch or damage inner ends) so that the "C" washers are seated in the counterbore in the differential side gears.

Select the proper axle shaft spacer so that there is from a free fit to .014" clearance between the ends of the axle shafts and the spacer. See Fig. 4.

Axle Shaft Spacers

There are three sizes of axle shaft spacers serviced for the ½ and all ¾-ton truck rear axles. The dimensions of these spacers are:

Narrow—1.1485" Wide Across Ground Surfaces.

Wide { 1.1575" Wide Across Ground Surfaces.
1.1675" Wide Across Ground Surfaces.

These three dimensions are obtained with the use of only two axle shaft spacers, the 1.1485" spacer being ground on only two sides, while the larger spacer is ground on all four sides to obtain both the 1.1575" and the 1.1675" dimensions.

After the proper clearance is obtained between the axle shafts and the spacer and it is properly installed in its place, assemble the pinion differential shaft and lock it in place with the special screw, using a lockwasher under its head.

Replace the axle housing cover, using a new cork gasket and fill the differential with the proper hypoid gear lubricant.

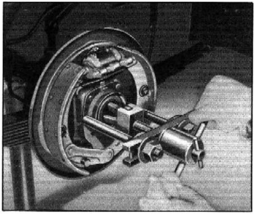

Fig. 5—Axle Shaft Bearing Puller

AXLE SHAFT BEARING

Disassembly

The wheel end of the axle shaft is mounted in a Hyatt roller bearing which is pressed into the axle housing. To remove this bearing, it is necessary to remove the wheels and axle shafts as previously described and insert the special bearing puller, K-344, shown in Fig. 5. This puller should be assembled into the bearing and the axle housing with the jaws

of the puller in a vertical position so as to keep them away from the welding flash on the inside of the axle housing. This tool not only removes the bearing but the bearing retainer on the inside and the leather oil seal on the outside.

Reassembly

To replace a new bearing and leather oil seal in the axle housing, the special driver, K-466-A, shown in Fig. 6, can be used to locate the bearing in its correct position.

With the bearing and inside bearing retainer and the outside leather oil seal assembled to the end of the driver, start the bearing into the axle housing. A few light blows with a hammer on the end of the tool will seat the bearing in its correct position, as well as the retainer and the oil seal. After the tool has been removed, the oil seal should be staked in place with a prick punch.

Assemble the axle shafts and wheels as previously described.

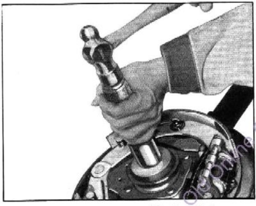

Fig. 6—Axle Shaft Bearing and Retainer Replacer

MAJOR SERVICE OPERATIONS

Removing Rear Axle Assembly

Raise the truck from the floor by the use of jacks and car horses, or by the use of a chain hoist and a lifting device. Remove both rear wheels and brake drums. Install wheel cylinder clamps on the brake wheel cylinders. Disconnect the hand brake cables from the brake pull rods, and remove the brake cables from the cable clamps on the frame. Disconnect the hydraulic connection at the rear axle housing. Disconnect the shock absorber "I" bolts from the spring seats. Remove the spring "U" bolts; disconnect the spring shackles and drop the springs. Slide the axle back to disconnect the torque tube at the front end. The axle is now free and can be moved to the axle stand.

During the disassembly operations, all adjustments should be closely checked. This inspection will be of material assistance in making the necessary repairs to insure a satisfactory job.

1. Check the clearance between the spacer and the end of the axle shafts.
2. Check ring gear and pinion back lash.
3. Check pinion depth in ring gear.
4. Check for ring gear being loose on the differential case.
5. Check and make sure the propeller shaft and pinion assembly rolls free in its bearings.
6. Check for looseness at the front propeller shaft bushing.

The axle shafts are removed as previously described and the third member is removed by the removal of the nuts which hold it to the axle housing. The differential assembly may be removed by taking out the two adjusting nut locks, the four differential carrier cap screws and removing the bearing caps and adjusting nuts.

The pinion and propeller shaft assembly can then be removed from the third member by removing the three tapered bearing retaining screws on the side of the carrier and letting it drop so that the spline end of the propeller shaft will strike on a wooden block or wooden floor and the pinion shaft will slide out. Remove the shims from the inside of the propeller shaft housing.

After the axle has been disassembled, all of the parts removed should be washed in cleaning solvent to insure absolute cleanliness.

Propeller Shaft Housing—½-Ton Truck

It is good practice when the propeller shaft is being removed from the propeller shaft housing, to check to see that there is not too much clearance between the propeller shaft and its bushing. If this clearance exceeds .010", the bushing should be replaced.

Propeller Shaft and Pinion Assembly

1. Inspect the splines for excessive wear or looseness in the universal joint; also inspect the shaft at the propeller shaft bushing location.
2. After the bearings have been thoroughly cleaned, oil with engine oil and check them for roughness. The double row thrust bearing should be checked for end play, because any end play in this bearing will allow the pinion to work back and forth, thereby changing the pinion depth in the ring gear.
3. Examine the pinion for cracked, chipped or scored teeth.

Propeller Shaft Bushing and Oil Seal Replacement

1. Drill out the dowel pins which retain the bushings and drive out both bushings and oil seal from the pinion end of the housing.

   NOTE—A new oil seal must be installed whenever the bushings are removed.

2. Start a new oil seal into the housing with the free side of the leather towards the front, then install a new rear bushing, driving both the oil seal and bushing firmly against their seat, using J-968 bushing driver. Drill the dowel hole in the bushing, being careful to control the depth. Coat the dowel with sealing compound to seal against leakage. Peen the dowel in place.
3. Install the front propeller shaft bushing, using J-968 bushing driver. When drilling the dowel pin hole in this bushing, great care must be exercised not to break through the wall of

the bushing. Due to the thin wall of this bushing, an arbor of the right size or a universal joint rear yoke should be used to prevent distortion while peening the dowel pin.

4. Any burrs that may have been set up during the peening operation should be dressed down with a fine cut mill file.

Propeller Shaft and Pinion Disassembly

The following covers the operations necessary when replacing the propeller shaft, pinion or the pinion bearings:

1. To disassemble the pinion from the propeller shaft, first drill the end of the rivet to clear the countersink into which it is upset, being careful to properly center the rivet with a center punch. Then drive out the rivet.
2. Loosen the pinion bearing lock nut and then disassemble the pinion from the propeller shaft.
3. Remove the front pinion bearing lock nut and press the bearing from the pinion, using J-996 pinion bearing remover.
4. Remove the rear pinion bearing lock ring and remove the bearing.

Reassembly

1. Install the rear Hyatt roller pinion bearing on the pinion shaft and install the lock ring in its groove in the shaft. Then thread the pinion front bearing oil retainer over the shaft with the bevel of the large diameter of the retainer toward the pinion.
2. Install the lock sleeve with its beveled side towards the pinion. Press the front (double row) bearing on the pinion shaft and install the bearing lock nut.
3. The pinion assembly may now be assembled to the propeller shaft by pressing the splined end into the coupling on the end of the propeller shaft so that the rivet hole in the pinion shaft lines up with the hole in the propeller shaft. Insert a new rivet in this hole and rivet over both ends.
4. Tighten the bearing lock nut and lock it in the milled slot in the pinion shaft.

Front Propeller Shaft—¾-Ton Truck

Instructions covering the repair of the ¾-ton front propeller shaft will be found on page 4-17 in this section.

Differential Assembly

1. Examine both differential side gear bearing surfaces in the differential case; also the thrust surfaces for the differential pinion gears.
2. Check both differential side bearings for roughness after they have been thoroughly cleaned and oiled.
3. Check each ring gear bolt to make sure they are all tight.
4. Inspect the differential side gears for scored hubs or thrust surfaces. Examine the internal splines and check their fit on an axle shaft.
5. Inspect the thrust surfaces on the differential pinion gears and check their fit on the pinion shaft.

   Any worn or damaged parts should be replaced.

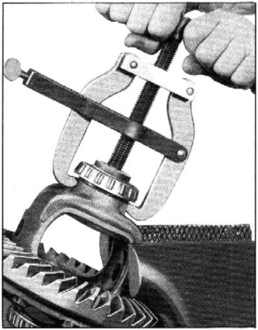

Fig. 7—Removing Differential Bearings

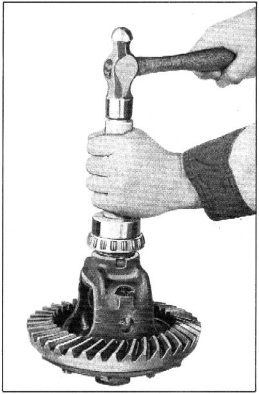

Fig. 8—Replacing Differential Bearings

Differential Bearing Replacement

The differential side bearings are a press fit on the hubs on each side of the differential case. These bearings must be removed and replaced as follows:

1. The legs of differential bearing puller, TR-278-R, should be fitted into the two notches in the case and the clamp screw tightened. Turning the puller screw will remove the bearing without damage to either the bearings or the case, Fig. 7.
2. After the bearings have been removed, they should be thoroughly cleaned, oiled and then checked for roughness.
3. To replace the differential side bearings, place them on the hubs with the thick side of the inner race towards the case and drive them in place with J-994 differential side bearing replacer, Fig. 8.

Ring Gear Replacement

1. Remove the bolts. The ring gear may then be tapped off the case with a soft-faced hammer.
2. Place the differential case in the "V" blocks of the checking fixture U-4 and indicate the run-out of both the ring gear pilot and the case flange, Fig. 9. Neither of these run-outs should exceed .001".
3. When replacing the ring gear, it is good practice to use five guide pins made by cutting the heads from ⅜"—24 cap screws about 1½" long. Slots should be cut in the heads of these guide pins so that they may be easily removed with a screwdriver. Install these guide pins in alternate bolt holes in the ring gear, Fig. 10, and slip the ring gear over the pilot diameter of the case, making sure that the back face of the ring gear and the face of the case are free from dirt and burrs. Install every other ring gear bolt and draw them up evenly and snugly so that the ring gear face is flush with the face of the case. Remove the guide pins and install the remaining bolts.

   Tighten all ring gear bolts.

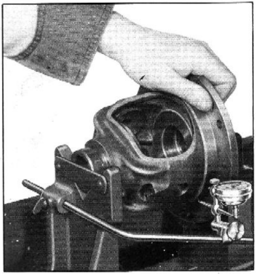

Fig. 9—Checking Run-Out of Differential Case

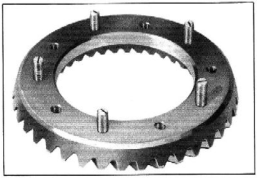

Fig. 10—Use of Guide Pins in Ring Gear

NOTE—New lockwashers should be used under the head of each bolt.

With the assembly mounted in "V" blocks, check the run-out of the back face of the ring gear with a dial indicator, Fig. 11. This run-out must not exceed .004".

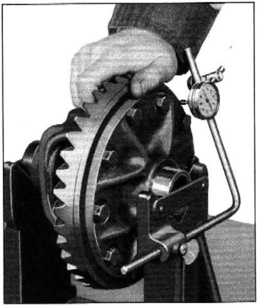

Fig. 11—Checking Run-Out of Back Face of Ring Gear

Assembling the Rear Axle

1. Assemble the same thickness of shims in the counterbore of the propeller shaft housing that were removed when the assembly was taken down (if the original ring gear and pinion are to be used), making sure that the shims are flat in the counterbore and are not cocked. The total thickness of the shims will be found to be from .030" to .036" and usually .033". Shims are serviced in thicknesses of .012", .015", .018", and .021" so that a combination of shims may be selected to replace the original ones if they are damaged.

NOTE—Whenever a new ring gear and pinion is installed, one .015" shim and one .018" shim should be used as this is the standard setup.

2. Assemble the propeller shaft assembly, driving it down until the bearings are seated in the housing. Drive by using a drift in the ⅞" hole in the pinion, and NOT on the pinion teeth.
3. Check through the bearing lock screw holes to make sure that the lock sleeve is in the correct position up against the back of the front pinion bearing. Install the three tapered lock screws and draw them down evenly and tightly. Tighten the lock screw lock nuts.

Ring Gear and Pinion Adjustment

1. Install the differential case assembly in the carrier and then install the adjusting nuts, taking care to slide these nuts alongside the bearings so that the threads on the nuts fit into the threads of the differential carrier. Install the bearing caps, making sure that the marks on the caps line up with the marks on the carrier. Tighten the cap screws until the lockwashers just flatten out.

NOTE—This adjustment should be made only with the third member assembly out of the rear axle housing.

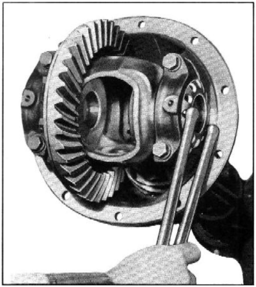

Fig. 12—Adjusting Ring Gear and Pinion Back Lash

2. Loosen the right-hand adjusting nut and tighten the left-hand adjusting nut, using differential adjusting wrench J-972, while at the same time turning the ring gear. Continue tightening the left-hand nut until all lash is removed, then back off the left-hand nut one notch.
3. Tighten the right-hand adjusting nut snugly (this position may easily be determined as the nut comes to a definite stop). Then tighten the right-hand nut from a minimum of one to a maximum of two notches more, to a locking position, Fig. 12.
4. Mount a dial gauge on the carrier and check the back lash between the ring gear and pinion, Fig. 13; this should be from .005" to .007".
   If the back lash is more than the above, loosen the right-hand adjusting nut one notch and tighten the left-hand adjusting nut one notch. If the back lash is less than above, loosen the left-hand adjusting nut one notch and tighten the right-hand nut one notch.
5. Tighten the bearing cap bolts securely, then recheck the back lash. Install both adjusting nut locks.
6. Assemble the third member assembly to the axle housing, using a new gasket. Lubricate the hubs of the differential side gears with hypoid gear lubricant and install them in the differential case.
7. Install the axle shafts, making sure that the longer shaft is used on the right-hand side, and install the "C" shaped axle shaft locks. Spread the ends of the axle shafts to make sure that

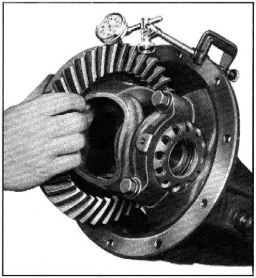

Fig. 13—Checking Ring Gear and Pinion Back Lash

the shafts, locks and differential side gears are in positive contact. Roll the two differential pinions into place and install the axle shaft spacer, pinion gear shaft and lock screw. Check the clearance between the end of the axle shaft and spacer—this should be from a free fit to .014". See Fig. 4.

8. Install the inspection cover, using a new cork gasket and fill the differential with 3½ pints of the proper hypoid lubricant.

To Replace the Rear Axle Assembly

Reverse the operation shown under the removal of the rear axle. Care should be taken to see that

all cotter pins are assembled and securely bent over. The "U" bolts holding the springs to the spring seats must be drawn up securely.

When connecting the brake cables, make sure that all of the play is out of the cables before installing the clevis pin.

After replacement of the rear axle, it will be necessary to bleed the brake lines at ALL FOUR WHEELS, as described in the "Brake Section" of this Manual.

Lubricate the universal joint through the battery ground cable bolt hole at the rear of transmission case. This provides initial lubrication for the universal joint and propeller shaft bushings.

REAR AXLE ASSEMBLY
1½-TON TRUCKS

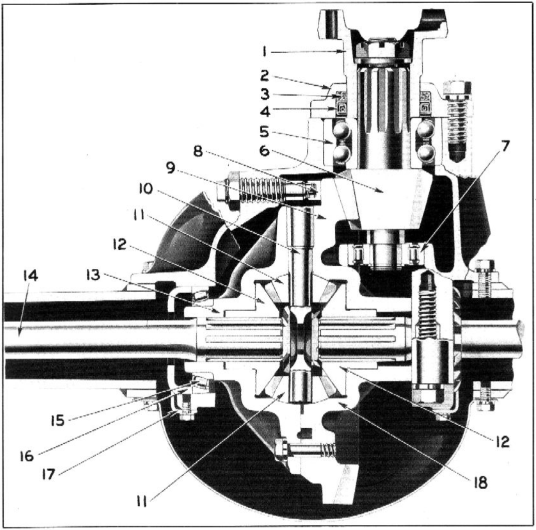

Fig. 14—1½-Ton Truck Rear Axle

1—Universal Joint Yoke
2—Pinion Bearing Retainer and Oil Seal
3—Oil Seal Packing
4—Oil Seal
5—Front Pinion Bearing
6—Drive Pinion
7—Rear Pinion Bearing
8—Ring Gear Thrust Pad
9—Ring Gear
10—Differential Spider
11—Differential Pinion (Spider) Gear
12—Differential Side Gear
13—Differential Case—Left Half
14—Axle Shaft
15—Differential Bearing
16—Differential Bearing Adjusting Nut
17—Adjusting Nut Lock
18—Differential Case—Right Half

Construction

The full-floating type rear axle used on 1½-ton trucks is so constructed that the axle shafts can be removed without removing the truck load or jacking up the rear axle. This axle is equipped with a hypoid ring gear and pinion, Fig. 14.

The differential bearing caps are piloted to the carrier by sleeve dowels, preventing any possibility of the bearing caps shifting.

The differential case is a two-piece case with the ring gear piloted to the right side. The case halves and the ring gear are bolted together with ½" bolts. This permits ring gear replacement without changing the differential case. The differential bearings are of Hyatt barrel roller type.

The front pinion bearing is a large double row ball bearing, and the rear pinion bearing is a large Hyatt roller bearing. A spring-loaded rawhide oil seal is used at the rear of the universal joint yoke.

The axle shaft to wheel hub gasket is made of soft sheet aluminum to reduce the load on the bolts. A lock plate is used to lock these bolts.

Identification of Rear Axles

The 6.16 to 1 rear axle ratio may be identified by the serial number stamped on the top right-hand side of the housing being prefixed by the letters "BR" or "BS."

The 5.43 to 1 ratio rear axle may be identified by the letters "BT" prefixed to the serial number.

MINOR SERVICE OPERATIONS

Axle Shaft Removal

1. With a cold chisel and hammer, bend the lugs of the lock plate away from the bolt heads.
2. Remove the eight ½" cap screws and lock plate.
3. Install two 7/16"—14 cap screws in the threaded holes provided in the axle shaft flange. Turning these cap screws alternately, the axle shaft may easily be removed. Remove the axle shaft and aluminum gasket, Fig. 15.

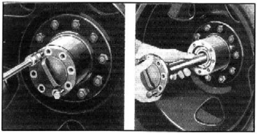

Fig. 15—Loosening and Removing Axle Shaft

Axle Shaft Replacement

Place a new aluminum axle shaft flange gasket on the axle shaft and push the shaft into the housing. Use a new lock plate at the axle shaft cap screws and insert the eight cap screws in the axle shaft flange, tightening them alternately and make sure they are all pulled up tight. Then bend the tangs of the lock plate against the heads of the cap screws.

Removal of Rear Wheel Bearings

1. Jack up the rear axle and remove the wheel and axle shaft.

   NOTE—Removal of the wheel is important; it prevents damage to the oil seal and permits more accurate adjustment of the bearings.

2. Raise the lip of the special lock from the notch in the lock nut. Remove lock nut with special wrench J 870, and remove the lock, inner adjusting nut, and thrust washer.

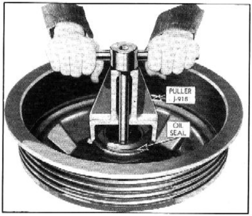

Fig. 16—Removing Inner Bearing and Oil Seal

3. Remove the hub and drum assembly.
4. Install brake wheel cylinder clamp to prevent the brake fluid from leaking should the brake pedal be accidentally depressed.
5. To remove the inner bearing and oil seal, use puller J-918-A.

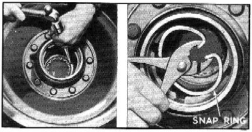

Fig. 17—Removing Outer Bearing Snap Ring

The puller is installed by tilting the plate with the chain attached, so that it may be slipped through the bearing and engage the outer race of the bearing. The plate is then held in this position by the chain while threading the puller shaft into the tapped hole. The puller body is then located against the housing and the bearing assembly and oil seal are removed by turning the puller handle, Fig. 16.

6. To remove the outer bearing, first tap the outer race to relieve the tension at the snap ring; then remove the snap ring on the inside of the hub, Fig. 17. Remove the bearing by driving on the

outer race of the bearing by using a long ⅛" punch through the cap screw holes in the end of the hub. This will also bring out the inner race and roller assembly.

NOTE—Care must be taken to engage the edge of the race with the punch and not damage the bearing seat in the housing; the race must also be driven out evenly.

Replacement of Rear Wheel Bearings

1. Check the fit of the inner races on housing; these races should be free to turn, but not loose.
2. Wash the bearings in cleaning solvent and pack the roller assemblies with Marfak lubricant or its equivalent, using No. 2 in Summer and No. 1 in Winter.
3. To replace the outer bearing, place the inner-race-and-roller assembly and the outer race in the wheel hub with the thin edge of the outer race downward. Use outer wheel bearing replacer, J-872-1, to press the bearing in the hub.

Fig. 18—Driving Outer Race into Contact with Snap Ring

CAUTION—Press the race only far enough to install the snap ring; this operation should be done in an arbor press.

Install the snap ring in the groove on the inside of the hub. Use special driver J-872-3 through the cap screw holes in the end of the hub to force the outer race back in positive contact with the snap ring, Fig. 18.

4. To replace the inner bearing, place outer race of the bearing in the wheel hub with the wide side of the race down. Use special driver J-872-4 to press the race against its seat. Install the inner race and roller assembly. Install the oil seal, using the wheel bearing oil seal replacer J-872-2, with an arbor press. Lock the seal in place by prick punching at three equally spaced places.
5. Install the wheel hub and drum assembly, turning the hub to properly line up the bearings.
6. Install the thrust washer and adjusting nut, Fig. 19.

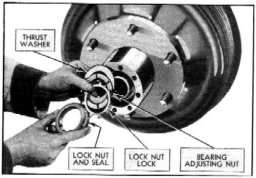

Fig. 19—Installing Thrust Washer, Adjusting Nut, Lock Nut and Lock Nut Lock

Adjustment of Rear Wheel Bearings

1. Using special wrench J-870, tighten the adjusting nut tight, then back it off 45 degrees. Turn the wheel hub by hand to make sure the hub turns freely.
2. Install the adjusting nut lock and check the alignment of the tangs with the slots in the nut.
3. Rotate the hub by hand, grasping the hub at the wheel bolts, to see that the bearings are properly seated and that the hub turns freely.
4. Bend the tang on the lock down into the notch of the adjusting nut. Install the outer lock nut and pull up tight to prevent any loosening of the adjusting nut. Bend the tang of the lock into the notch of the lock nut.
5. Install the axle shaft, and a new aluminum gasket.
6. Install the lock plate.
7. Install the axle shaft bolts and tighten securely.

Replacement of Oil Slinger

The location of the oil slinger requires that it be driven on the rear axle housing. If for any reason

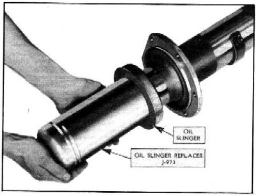

Fig. 20—Oil Slinger Replacer

the oil slinger is removed, it must be replaced with a new one.

A special tool is necessary for this purpose because the slinger must be located with relation to the bearings. The oil slinger replacer J-973 is designed so it will pilot on the housing and drive the slinger into proper position so it will mate with the oil slinger in the wheel hub, Fig. 20.

MAJOR SERVICE OPERATIONS

Differential Carrier Removal

To remove the differential carrier or third member from the truck, proceed as follows:

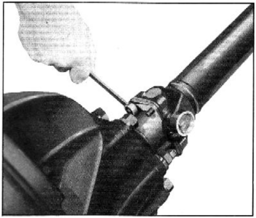

Fig. 21—Removing Rear Universal Joint "U" Bolts

1. Drain lubricant from differential, remove differential cover and axle shafts.
2. Split the rear universal joint by removing the two trunnion bearing "U" bolts from the rear yoke as shown in Fig. 21. The bearings can be left on the trunnion and held in place with tape. This will prevent dirt getting into the bearings as well as saving considerable time in reassembly.

   Sufficient clearance can be obtained for dropping the propeller shaft by sliding the entire assembly forward on the splines of the propeller shaft.
3. Remove the bolts and lockwashers which retain the differential carrier assembly to the axle housing and remove the differential carrier.

Disassembly

1. Mount the assembly in a bench vise and remove the ring gear thrust pad. Remove differential adjusting nut locks. Remove the bearing cap bolts and lockwashers. The bearing caps may now be removed. Then remove the differential case and ring gear assembly from the carrier.
2. Remove the bolts from the pinion bearing retainer and oil seal, remove the pinion and shaft assembly from the carrier.

Pinion Disassembly

1. Clamp the rear yoke of the universal joint in a bench vise and remove the cotter pin, nut and

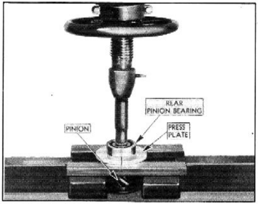

Fig. 22—Removing Rear Pinion Bearing

washer from the end of the pinion shaft.

   The universal joint as well as the bearing retainer and oil seal may then be removed from the pinion shaft.
2. To remove the rear pinion bearing, take off the lock ring and then, using a special press plate, J-1453, press the pinion and shaft out of the bearing, Fig. 22.

   NOTE—The raised portion of the press plate must be against the inner race otherwise the bearing will be damaged.
3. Install the front pinion bearing remover J-1439 for 6-tooth pinions, J-1440 for 7-tooth pinions, over the pinion teeth and against the inner race of the double row bearing. Then press the bearing off the pinion shaft, Fig. 23.

Inspection

Wash all parts in cleaning solvent. Inspect the pinion for worn or chipped teeth. Inspect the splines

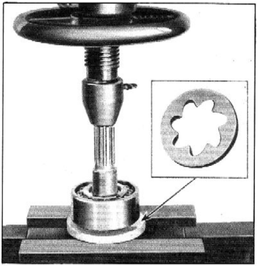

Fig. 23—Removing Front Pinion Bearing

on the pinion shaft for wear or scoring. Oil the bearings and turn them slowly by hand to check for roughness. Check the fit of the bearings in the carrier. These should be a close push fit by hand. Inspect the oil seal in the pinion bearing retainer and replace with a new one if necessary.

Pinion Reassembly

1. Press the front double-row bearing onto the pinion shaft with the extended portion of the bearing inner race toward the back of the gear teeth.
2. Press the rear bearing on the end of the shaft with the chamfered side of the inner race towards the pinion. Install the lock ring, using the lock ring installer J-1364, Fig. 24.
3. Slide the pinion bearing retainer and oil seal over the universal joint yoke. If replacement of the oil seal is necessary, install the felt packing toward the bottom of the recess and then the oil seal with the open end of the leather toward the pinion bearing. The oil seal should be pressed down against the felt packing, see Fig. 14.

NOTE—Soak a new leather oil seal in light engine oil for at least one hour before installing.

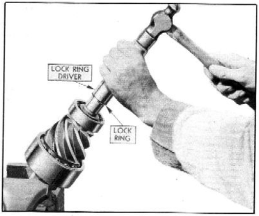

Fig. 24—Rear Pinion Bearing Lock Ring Installer

4. Install the pinion bearing retainer gasket and then slide the universal joint yoke over the splines on the pinion shaft until it contacts the inner race of the bearing.
5. Place the flat washer on the end of the pinion shaft and tighten the nut down to a torque load of 160 to 280 ft. lbs. Lock the nut in place with the cotter pin.

Differential Disassembly

The differential side bearings are a press fit on each side of the differential. To remove these bearings, the special puller TR-278-R, shown in Fig. 25, should be assembled to the case with the two fingers of the puller in the two notches of the case. This allows the fingers to pull in against the inner race of the bearing which will prevent damage to the bearing. These bearings should never be removed in an arbor press because removing them in this way will damage the bearings so that they will be unusable.

After the bearings have been removed, they should be washed in cleaning solvent and blown out with clean air. They should then be oiled and rotated by hand, to check for roughness.

To disassemble the differential, check and make sure the case halves are marked (Fig. 26) so it may be assembled in the same position. Remove the twelve ½" bolts from the case. Lift off the case cover and remove the differential gears and pinions.

The ring gear may be removed from the right-hand side of the case by tapping it with a soft-faced hammer.

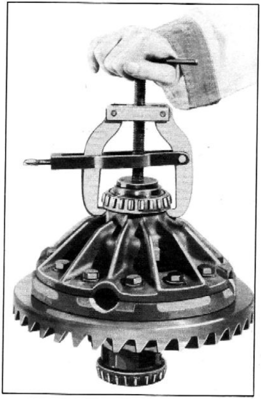

Fig. 25—Differential Bearing Puller

Inspection

Wash all parts thoroughly in cleaning solvent. Check all gears for chipped, cracked or scored teeth. Inspect the differential side gear and pinion thrust surfaces in the housing halves for wear or score marks. Check the fit of the side gear hubs in the differential case halves. The fit of the pinions should be checked on the spider. The differential side bearings should be carefully inspected for worn, checked, scored or broken rollers. They should then be oiled and rotated by hand to check for roughness.

Any damaged or worn parts should be replaced.

NOTE—If any one of the differential gears are damaged or scored all should be replaced.

Reassembly

When reassembling the differential, the flanges of the case, ring gear pilot and the back of the ring gear must be clean and free from burrs.

When replacing the ring gear, it is good practice to use two guide pins made from differential and ring gear screw, part No. 3652253. Their ends should be slightly tapered and screwdriver slots cut so they may be easily removed, Fig. 27.

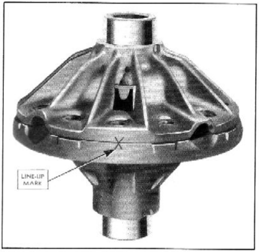

Fig. 26—Differential Case Marks

1. Lubricate the differential side gears and pinions and install them in the left half of the differential case.
2. Assemble the right side of the case to the left side, being sure to line up the marks on the case halves, Fig. 26.

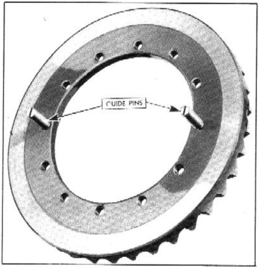

Fig. 27—Guide Pins in Ring Gear

3. Install the guide pins. Slip the ring gear over the pilot diameter of the right-hand half of the differential case.
4. Install ten differential to ring gear cap screws and lockwashers, tightening them evenly one turn at a time until the ring gear face is flush with the case flange. Remove the guide pins and install the two remaining bolts and lockwashers. Then pull up all twelve bolts *tight.*
5. Assemble the differential side bearings to the case, using the special driver, J-1488.

   NOTE—The wide side of the inner race must be towards the case.

Differential Carrier Reassembly

1. Place the differential carrier in a vise and install the bearing cap dowels in the carrier or in the bearing caps.
2. Assemble pinion assembly to the carrier using new gaskets and tighten the pinion bearing retainer bolts securely.
3. Install the differential assembly in the carrier. Install the bearing caps, making sure the marks on the caps line up with marks in the carrier. Install the cap screws and tighten them until the lockwashers just flatten out. Screw the adjusting nuts into the carrier, making sure they turn freely. Tighten them snugly to straighten up bearing outer races.

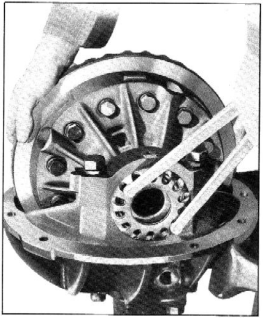

Fig. 28—Adjusting Ring Gear and Pinion Back Lash

4. Back off the right-hand adjusting nut and tighten left-hand adjusting nut, using wrench J-972, just to a point where all lash between the ring gear and pinion is removed. Then back off the left-hand nut approximately two notches and to locking position. Tighten right-hand nut to solid

position. Back off right-hand nut free of bearing, then tighten up right-hand nut until all play in bearing is removed and then one to two notches more to a locking position, Fig. 28.

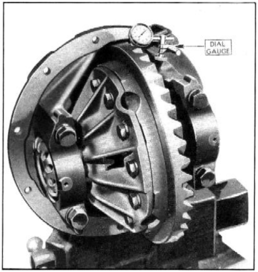

Fig. 29—Checking Ring Gear and Pinion Back Lash

5. Check ring gear and pinion back lash. This should be from .005"-.008". If it is more than .008", loosen the right-hand adjusting nut one notch and tighten left-hand nut one notch. If less than .005", loosen the left-hand nut one notch and tighten the right-hand nut one notch. Tighten down the cap screws and recheck the ring gear and pinion back lash with a dial gauge as shown in Fig. 29. Assemble and tighten the adjusting nut locks.

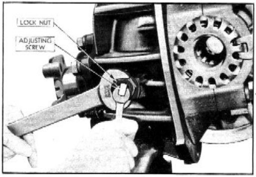

Fig. 30—Ring Gear Thrust Pad Adjustment

6. Examine the bronze tip of the ring gear thrust pad and, if worn, install a new one.
7. Install the thrust pad and tighten the screw until the bronze tip lightly engages the back of the ring gear while rotating gear. Back off the screw one-twelfth (1/12) of a turn and then tighten the lock nut, making sure the screw does not turn during the locking process. This will provide .005" to .007" clearance, Fig. 30.

Reassembly of Rear Axle

1. Clean out axle housing and cover. Install the third member assembly in the axle housing, with a new gasket between the carrier and the housing. Install the cap screws and tighten them securely.
2. Assemble the axle shafts, using a new aluminum gasket between the axle shaft flange and wheel hub. Install the bolts through a new locking plate and pull them down tight. Lock the bolts by bending the tangs on the locking plate firmly against each bolt head.
3. Assemble the rear universal joint.

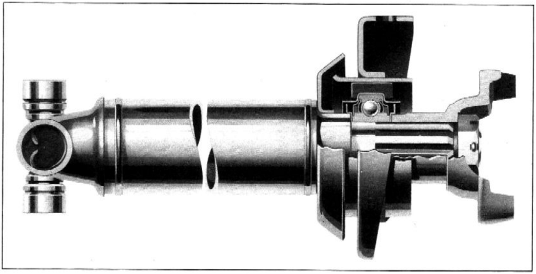

Fig. 31—1½ Ton Front Propeller Shaft

4. Replace the axle housing cover and gasket.
5. Fill the rear axle with eleven (11) pints of lubricant of the type recommended in the Lubrication Section.

PROPELLER SHAFTS

1½ Ton Trucks

The drive line from the transmission to the rear axle comprises two tubular propeller shafts and three needle bearing universal joints. On the front propeller shaft the rear yoke of the front universal joint is an integral part of the propeller shaft. The rear end of this shaft is machined to receive the support bearing, and it is also splined and threaded to mount the front yoke of the intermediate universal joint, Fig. 31.

The support bearing is mounted in the support bracket by means of a rubber cushion which fits over the outer race of the bearing and inside a sleeve in the support bracket. This bearing is of the permanently lubricated and sealed type.

On the rear propeller shaft the front yoke of the rear universal joint is an integral part of the propeller shaft. The front end of this shaft is splined to fit the splines in the rear yoke of the intermediate universal joint.

UNIVERSAL JOINTS

All three universal joints are of the needle bearing type. The front and rear yoke of each universal is machined to receive the trunnion bearings. The bearings are anchored to the front yokes of the front and intermediate universals and the rear yoke of the rear universal by "U" clamps. The bearings in the rear yokes of the front and intermediate universals and the front yoke of the rear universal are pressed into the yokes and locked by snap rings. The front yoke of the front universal is splined to the transmission main shaft, and the rear yoke of the rear universal is splined to the rear axle drive pinion.

Each trunnion is drilled and fed by a central lubrication fitting for lubricating the bearings, Fig. 32. On the side opposite the lubrication fitting, a relief valve is mounted. This valve is adjusted to "pop" at from 40 to 80 pounds pressure, thereby preventing overlubrication or damage to the trunnion bearing seals.

A lubrication fitting is mounted on the rear yoke of the intermediate universal to lubricate the splines, Fig. 32. A plug is staked into the forward end of the splined opening to retain the lubricant. A small hole is drilled in the center of this plug to relieve trapped air. The rear end of the splined opening is sealed by a cork packing contained in a retainer cap which screws on the end of the yoke.

Propeller Shaft Disassembly

1. Remove the nuts from the trunnion bearing "U" clamps and remove the clamps. (This may be done at either or both the transmission end and/or the rear axle end depending upon the amount of disassembly desired.)
2. Unscrew the oil seal retainer from the rear yoke of the intermediate, or center, universal joint.

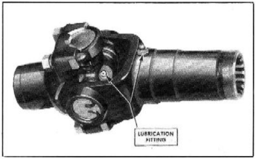

Fig. 32—Truck Intermediate Universal Joint

3. Remove the rear propeller shaft from the front propeller shaft by slipping it out of the universal joint splines.
4. Split the front universal joint at the transmission end of the front propeller shaft.
5. Remove the two bolts which mount the intermediate universal joint support bracket to the frame cross member.
6. Disconnect the intermediate universal joint by removing the two trunnion-bearing "U" clamps.
NOTE—To hold the trunnion bearings in place as well as to prevent dirt entering and save time in reassembling, leave the bearings in the trunnion and tape them in place.
7. Clamp one side of the front yoke of the intermediate universal in a bench vise and remove the retaining nut with a 1½" socket wrench.
8. Using a soft hammer for the purpose, tap the yoke from the propeller shaft.
9. Wet the rubber cushion located in the support bracket with water to soften the soap used on the rubber when assembled. Mount the support bracket in a bench vise and move the propeller shaft from side to side to work the rubber cushion out of the support.
10. After the support bracket has been removed, the rubber cushion can be removed from the bearing with the hands as shown in Fig. 33.

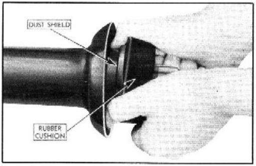

Fig. 33—Removing or Replacing Bearing Rubber Cushion

11. Mount the special puller, J-1619, in a bench vise and fit the jaws of the puller in behind the bearing outer race. Turning the screw of the puller will remove the bearing from the shaft, Fig. 34.

12. Tap the dust shields off the outer race of the bearing. Fig. 35 shows a layout of the parts making up the intermediate support bearing assembly.

Inspection

Thoroughly wash all parts, EXCEPT THE SUPPORT BEARING, in cleaning solvent. Inspect the shaft for worn splines and replace shafts if necessary. Check the bearing for roughness or excessive play by holding the inner race with one hand while slowly turning the outer race with the other. If either condition is present, replace the bearing.

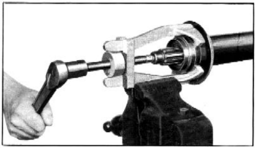

Fig. 34—Removing Propeller Shaft Intermediate Bearing

NOTE—The intermediate support bearing is of the permanently lubricated and sealed type, therefore, no attempt should be made to wash it out with cleaning solvent or to re-lubricate it.

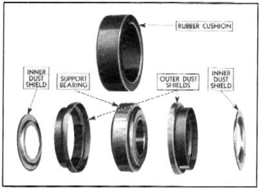

Fig. 35—Layout of Intermediate Support Bearing Parts

Propeller Shaft Reassembly

1. Press the outer dust shields on the outer race of the support bearing.
2. Place one of the inner dust shields on the shaft with the offset in the shield away from the bearing as shown in Fig. 35. Drive the bearing on the shaft using the universal joint yoke as a driver. Then install the other inner dust shield on the shaft with the offset away from the bearing.
3. Install the rubber cushion over the bearing as shown in Fig. 33.
4. Coat the outside surface of the rubber cushion lightly with soft soap and slide the support bracket over the rubber cushion as in Fig. 36.
5. Install the front yoke of the intermediate universal joint, making sure that the yoke is turned 90 degrees, in relation to the rear yoke of the front universal joint which is a part of the propeller shaft. Then by installing the rear yoke of the intermediate universal onto the rear propeller shaft so that it is in the same plane (line) with the front yoke of the rear propeller shaft rear universal joint, it will correctly align all three universal joints.
6. Reassemble the front universal joint and then bolt the intermediate support bracket to the frame cross member.
7. Assemble the rear propeller shaft and adjust the packing retainer on the rear sleeve yoke of the intermediate universal joint.

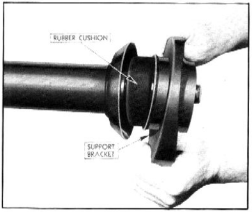

Fig. 36—Installing Bearing Support Bracket

NOTE—When necessary to replace a cork oil seal in this retainer, press the old one out of the retainer, and, because it is split, Fig. 37, it can then be removed from the propeller shaft.

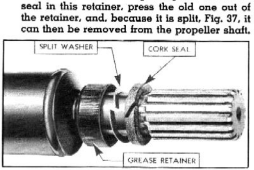

Fig. 37—Packing at Intermediate Joint Rear Yoke

8. Lubricate the universal joints with S.A.E. 90 gear lubricant—(transmission lubricant).

FRONT PROPELLER SHAFT ASSEMBLY

¾ Ton Trucks

The front propeller shaft assembly used on the ¾ ton truck differs from that used on the 1½ ton models in that it is of the enclosed type, Fig. 38.

The housing incorporates the universal ball as part of the assembly. A thin wall bushing is pressed into the front end of the housing tube.

The hub of the rear yoke of the front universal joint takes its bearing in this bushing. The rear end of the shaft is supported by a single row ball bearing of the permanently lubricated and sealed type. A spring loaded oil seal is pressed into the housing ahead of the bearing and a dust shield is assembled on the shaft at the rear of the bearing.

A rubber cushion slips over the machined rear end of the housing. This cushion in turn fits inside the sleeve which is a part of the support bracket.

Removal from Truck

1. Split the intermediate universal joint by removing the two trunnion bearing "U" clamps from the front yoke of the universal. Tape the bearings as already described and drop the front end of the rear propeller shaft.
2. Remove the four bolts which attach the universal ball retainer to the rear end of the transmission and slip the retainer back on the tube.
3. Remove the nuts from the bolts which attach the support bracket to the cross member. Then pull the assembly towards the rear to clear the splines in the front universal joint.

Disassembly

1. Clamp one side of the universal joint yoke in a bench vise. Remove the cotter pin and nut from the shaft. The yoke may now be tapped off the shaft splines with a soft hammer. Remove the bearing dust shield.
2. Wet the inside of the sleeve in the support bracket with water to soften the soap used when assembling. Place the bracket in a bench vise, then by moving the housing from side to side and at the same time pulling on the housing, it may be removed from the support bracket.
3. Remove the rubber cushion from the housing by slipping it off the machined part of the housing. The universal ball retainer may then be removed over the rear end of the housing.
4. With a pair of pliers compress the tangs on the end of the bearing retainer snap ring and remove the snap ring.
5. Using a brass drift and hammer drive the propeller shaft and bearing from the housing.
6. The bearing may now be removed by pressing it off the shaft in an arbor press.

Wash all parts except the bearing thoroughly in cleaning solvent.

Examine the leather oil seal for wear or damage.

NOTE—The seal should not be removed unless for the purpose of replacement. To remove the seal drive it out from the front of the housing using a piece of shafting. When installing a new seal, be sure that the free end of the leather is toward the front end of the housing.

NOTE—The seal should be thoroughly soaked in light engine oil before assembling.

Inspect the bushing in the front of the housing for wear. Check the ball bearing for roughness by turning it by hand.

Propeller Shaft Bushing Replacement

Drill out the dowel pin which retains the bushing and drive out bushing from pinion end of housing. A new oil seal must be installed whenever the bushing is removed.

Reassembly

1. Press the bearing on the shaft in an arbor press.
2. Assemble the shaft and bearing in the housing. Seat the bearing by tapping around its outer race using a soft drift punch and hammer. Then install the snap ring.
3. Install a new cork packing in the universal ball retainer. It is recommended that the packing be shellacked to the retainer. Install the retainer over the housing.
4. Install the rubber cushion over the machined end at the rear of the housing.
5. Coat the rubber cushion lightly with soft soap and assemble the support bracket over the cushion.
6. Install the bearing dust shield and universal joint front yoke. Tighten the nut and cotter pin securely.

Replacement in Truck

1. Place the transmission in gear and then slide the splines of the front propeller shaft into the rear yoke of the front universal joint.
2. Bolt the support bracket to the cross member.
3. Lubricate the universal ball and then bolt the universal ball retainer to the rear end of the transmission housing.

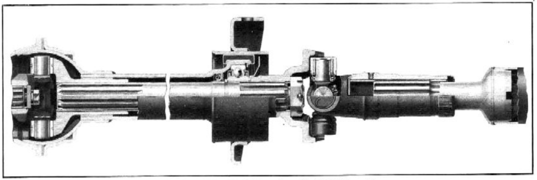

Fig. 38—¾ Ton Truck Front Propeller Shaft Assembly

4. Raise the rear propeller shaft; remove the tape from the trunnion bearings. Seat the bearings in the front yoke of the universal; install the "U" clamps and tighten the nuts securely.
5. Lubricate the intermediate universal joint with S.A.E. 90 transmission lubricant and lubricate the front universal by filling the housing with 1 pint of S.A.E. 90 transmission lubricant.

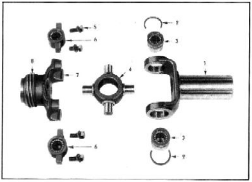

Fig. 39—½ Ton Truck Universal Joint

1—Front Universal Yoke
2—Trunnion Bearing Lock Ring
3—Front Trunnion Bearing and Rollers
4—Universal Joint Trunnion
5—Cap Screw
6—Rear Trunnion Bearing and Rollers
7—Rear Universal Yoke
8—Speedometer Drive Gear

UNIVERSAL JOINT

½ Ton Truck

The universal joint is a fully enclosed needle bearing unit. This type unit provides great smoothness and durability, and at the same time reduces friction. Figure 39 shows a layout of the universal joint parts.

Service operations of the universal joint are as follows:

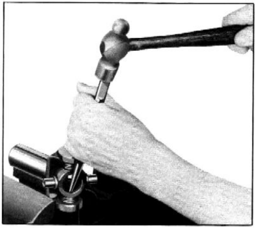

Fig. 40—Disassembly of Universal Joint

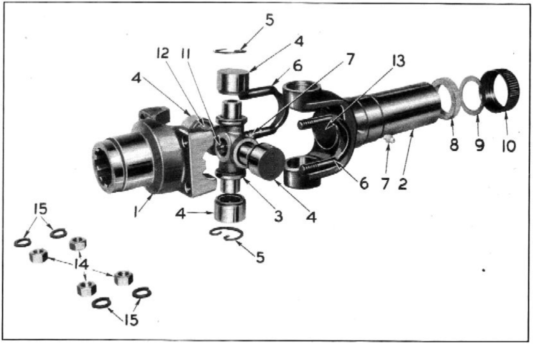

Fig. 41—Layout of Truck Intermediate Universal Joint

1—Universal Joint Yoke
2—Universal Joint Sleeve Yoke
3—Yoke Trunnion
4—Trunnion Bearing
5—Trunnion Bearing Lock Ring
6—"U" Bolt
7—Lubrication Fitting
8—Oil Seal
9—Washer
10—Packing Retainer
11—Relief Valve
12—Trunnion Bearing Rollers
13—Air Vent
14—"U" Bolt Retaining Nuts
15—Lockwashers

Disassembly

1. Remove the four cap screws which fasten the retaining collar to the ball retainer and slide the ball back on the propeller shaft housing.
2. Remove the four cap screws which fasten the front trunnion bearings to the front yoke. Remove the two front yoke trunnion bearings and split the joint.
3. The rear yoke and trunnion can then be removed from the propeller shaft splines. The front yoke can be removed from the transmission mainshaft by removing the bolt and lockwasher.
4. Wash all parts in cleaning solvent, and inspect the yokes, trunnion, and bearings for wear. Worn or damaged parts must be replaced.
5. Remove the lock rings from the trunnion bearings and drive the caps from the yoke, using a drift punch in the center of the trunnion as shown in Fig. 40. After the trunnion has been driven down to the yoke, raise the trunnion and slip a flat washer 15/16" in diameter over the bearing. Again drive on the center of the trunnion until the bearing is free of the yoke. This method prevents cocking the bearing, which would result in damage to both the yoke and the bearing.

Reassembly

1. Install the front yoke on the transmission mainshaft. Install the lockwasher and bolt.
2. Install the trunnion by threading it into the rear yoke.
3. Coat the inside of the trunnion bearings with light cup grease and install the 19 roller bearings. Then start the trunnion bearings into the rear yoke, at the same time fitting the ends of the trunnion into the bearings. Press each bearing into the yoke just far enough to install the snap ring. Install the rear yoke and trunnion on the propeller shaft splines.
4. Install the rollers in the front yoke trunnion bearings and place them on the ends of the trunnion. Line up the trunnion bearings with the front yoke, making sure the pilots on the trunnions fit into the opening of the yoke. Install the lockwashers and cap screws and tighten them securely.
5. Slide the universal ball forward and install the four cap screws which attach the retainer collar to the rear of the transmission. Fill the universal joint housing with transmission lubricant through the opening for the speedometer driven gear.

UNIVERSAL JOINTS

¾ Ton and 1½ Ton Trucks

Whenever it becomes necessary to remove the trunnion and trunnion bearings from the rear yokes of the front or intermediate universals and the front yoke of the rear universal, the snap rings and lubrication fittings should be removed. Support the yoke on a bench vise, then, using a soft drift and hammer, drive on the end of one trunnion bearing. The shock loads of the hammer blows are transmitted through the trunnion to the other trunnion bearing driving it out of the yoke, Fig. 42.

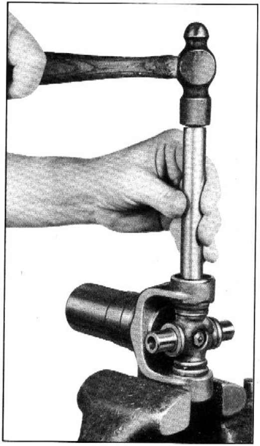

Fig. 42—Removing Trunnion Bearings from Joint Yoke

Care should be exercised when driving through the trunnion not to drive it into the side of the yoke. After one bearing has been removed, support the other side of the yoke on the vise and drive the other bearing out by using a brass drift on the end of the trunnion pin.

When reassembling the bearings they should be pressed into the yokes just far enough to install the snap rings. Then, while holding the trunnion in one hand, strike the yoke a few light blows with a hammer to firmly seat the bearings against the lockrings.

REAR SPRINGS

The rear springs on all truck models are of the semi-elliptic type and are designed for each individual unit to provide adequate load-carrying capacity and a spring rate which is proportional to that of the front springs to give the smoothest ride possible. The rear spring data is given in the specifications at the end of this section.

Rear Spring Shackle

The threaded type spring shackle is used at the rear of the rear spring on the ½ ton truck, Fig. 43.

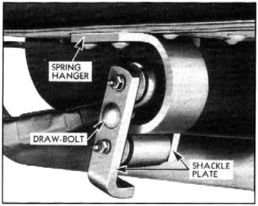

Fig. 43—½ Ton Truck Rear Shackle

To replace the threaded bushing raise the truck with a chain hoist just enough to relieve the spring tension. Remove the draw bolt and the shackle plates. Unscrew the shackle pins from the bushings. The threaded end of the bushing removing and replacing tool J-553 should be screwed into the threaded bushing. Turning the pull nut on the tool with a wrench will remove the bushing.

To install a new bushing insert the threaded end of the tool through the spring eye or spring hanger and screw a new bushing on the shaft of the tool. Turning the pull nut on the tool will draw the bushing into place. Screw a new shackle pin into the bushing until each end projects 21/32" from the end of the bushing. Place the four cork gaskets over the ends of the pins and assemble the shackle plates. Insert the draw bolt and draw the nut up snugly. Strike each end of the shackle a sharp blow with a hammer to insure seating of the tapers and retighten the shackle bolt.

Examine the lubrication fittings for damage. Replace them when necessary and fill the pins completely full with chassis lubricant.

PLAIN BUSHED SHACKLE

This type of shackle is used at the rear of the rear springs on all ¾ and 1½ ton trucks, Fig. 44. It consists of a heavy malleable shackle bushed at the upper end to serve as a bearing for the upper shackle pin which passes through the shackle and the spring hanger, and a lower shackle pin which passes through the shackle and the spring eye bushing. A "pinch" bolt at the spring hanger keeps the upper pin from turning while the lower pin is anchored in the same way by the "pinch" bolt at the shackle.

The upper shackle pin may be removed by first removing the "pinch" bolt and then driving the pin out from the inside, using a drift through the hole in the frame side rail for that purpose. The shackle pin at the front of the rear spring may be removed by driving the pin from the spring eye bushing, through the hole in the frame side rail, and into the "alligator jaw" of the frame cross member.

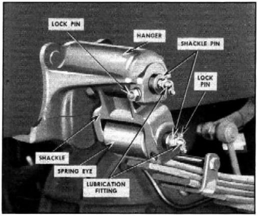

Fig. 44—¾ and 1½ Ton Truck Rear Shackle

If the spring eye bushings or shackle bushings require replacement, press out the spring eye bushings, using driver J-1668 and the shackle bushings, using driver J-1667.

After pressing in the new bushing on an arbor press, use a .877" reamer to provide .002" to .004" clearance between the housing and the shackle pin.

NOTE—On all ¾ ton trucks the rear springs are 2" wide, while on the 1½ ton truck they are 2½" wide. In order to use the same shackle bracket on both trucks it is necessary to use ½" spacers on all ¾ ton models to fill this space. These spacers are located on the inner side of the spring.

FITTING ½ TON TRUCK REAR SPRING SEATS

If it becomes necessary to adjust the rear spring seats on the truck models the correct clearance between the spring seat and the rear axle housing may be obtained as follows:

1. Jack up the rear end of the truck and block it in this position by using car horses under the frame side rails.
2. Disconnect the spring shackle and drop the rear end of the spring.
3. Remove the spring U-bolts.
4. Remove the two screws from the lower spring seat cap and remove both halves of the spring seat.
5. Clamp the two halves of the spring seat in a bench vise and file evenly from face of each half. Assemble the spring seat to the axle housing and check the fit of the seat on the housing. Continue to file evenly from both halves until such a fit is obtained that a slight drag is felt when turning the spring seat on the axle housing.

REAR AXLE TROUBLES AND REMEDIES

Symptom	Probable Remedy
Axle Noisy on Drive	
1. Ring gear and pinion adjustment too tight.	1. Readjust ring gear and pinion (see Instructions).
2. Rear side of double row pinion bearing rough.	2. Replace bearing and readjust ring gear and pinion.
Axle Noisy on Coast	
1. Excessive lash between ring gear and pinion.	1. Readjust ring gear and pinion (see Instructions).
2. Front side of double row bearing rough.	2. Replace bearing and readjust ring gear and pinion.
3. End play in double row bearing.	3. Replace bearing and readjust ring gear and pinion.
Axle Noisy on Both Drive and Coast	
1. Pinion too deep in ring gear.	1. Double row bearing installed backward (see Instructions — Pinion Reassembly).
2. Ring and pinion adjustment too tight.	2. Readjust ring gear and pinion (see Instructions).
3. Worn or damaged pinion or differential bearings.	3. Replace damaged bearing or bearings.
4. Loose or worn wheel bearings.	4. Adjust or replace bearings as necessary.
Backlash	
1. Axle shaft flange loose.	1. Replace aluminum gasket, retighten and lock axle shaft flange bolts.
2. Worn differential and side gear spacers.	2. Replace any worn spacers.
3. Worn universal joints.	3. Replace worn universal joint parts.

TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling the rear axle:

½ Ton and ¾ Ton Rear Axle

Tool Number	*Description*
J-973	Oil Slinger Replacer
J-554	Axle Shaft Peening Tool and Anvil
K-344	Axle Shaft Bearing Puller
K-466-A	Axle Shaft Bearing and Retainer Replacer
J-968	Propeller Shaft Bushing Driver
J-996	Pinion Bearing Remover
TR-278-R	Differential Bearing Puller
J-994	Differential Side Bearing Replacer
U-4	Differential Checking Fixture
J-972	Differential Side Bearing Adjusting Wrench
J-553	Spring Bushing Removing and Replacing Tool (½ Ton)

1½ Ton Rear Axle

J-870	Rear Wheel Bearing Lock Nut Wrench
J-918-A	Inner Bearing and Oil Seal Puller
J-872-1	Outer Wheel Bearing Replacer
J-872-3	Special Bearing Race Driver
J-872-4	Special Bearing Race Driver
J-872-2	Bearing Oil Seal Replacer
J-973	Oil Slinger Replacer
J-1453	Rear Pinion Bearing Press Plate
J-1439	Front Pinion Bearing Remover (6-Tooth Pinion)
J-1440	Front Pinion Bearing Remover (7-Tooth Pinion)
J-1364	Rear Pinion Bearing Lock Ring Installer
TR-278-R	Differential Side Bearing Puller
J-1488	Differential Side Bearing Driver
J-972	Differential Side Bearing Adjusting Wrench

REAR AXLE SPECIFICATIONS

	½-Ton Truck	All ¾-Ton Trucks	Heavy Duty 1½-Ton Trucks
Type	Semi-Floating	Semi-Floating	Full-Floating
Type of Gearing	Hypoid	Hypoid	Hypoid
Regular Gear Ratio	4.111 to 1	4.55 to 1	6.17 to 1
Number of Gear Teeth	37	41	37
Number of Pinion Teeth	9	9	6
Optional Gear Ratio	None	None	5.43 to 1
Number of Ring Gear Teeth	—	—	38
Number of Pinion Teeth	—	—	7
Back Lash Between Ring Gear and Pinion	.005" to .008"	.005" to .008"	.005" to .008"
Clearance Between Axle Shaft and Spacer	Free Fit to .014"	Free Fit to .014"	—
Allowance Run-Out of Propeller Shaft Assembly at:			
Front Bearing	.002"	.002"	.003"
Front of Rear Splines	.010"	.010"	.010"
Center of Propeller Shaft	.015"	.015"	.015"
Extreme Forward End	.005"	.005"	.005"
Allowable Run-Out of Differential Case at:			
Ring Gear Pilot	.004"	.004"	.004"
Face to Which Ring Gear is Bolted	.004"	.004"	.004"
Back of Ring Gear After Bolted to Case	.007"	.007"	.007"
Clearance Between Thrust Pad and Back of Ring Gear	—	—	.005" to .007"

	½-Ton Truck	¾-Ton Trucks	1½-Ton Trucks
Front Pinion Bearing	New Departure ND-5306	New Departure ND-5306	New Departure ND-H-5310A
Rear Pinion Bearing	Hyatt U-1506	Hyatt U-1506	Hyatt U-1305
Differential Side Bearing	Hyatt KA-11445Z	Hyatt KA-11445Z	Hyatt KA-11820Z
Wheel Bearing (Inner)	—	—	Hyatt KD-12051
Wheel Bearing (Outer)	Hyatt C-1500	Hyatt 1512	Hyatt KB-11786
Propeller Shaft Support Bearing	—	New Departure NDX-88107	New Departure NDX-88107

	½-Ton	¾-Ton	1½-Ton Except Panel	1½-Ton Panel
REAR SPRINGS				
Type	Semi-Elliptic	Semi-Elliptic	Semi-Elliptic	Semi-Elliptic
Length	54⅛"	46"	46"	46"
Width	1¾"	2"	2½"	2½"
Number of Leaves	8	7	10	8
Leaf Thickness				
Nos. 1, 2, 3, 4	.291"	.291"	.323"	.291"
No. 5	.291"	.323"	.323"	.291"
Nos. 6, 7	.291"	.323"	.323"	.323"
No. 8	.291"	—	.323"	.323"
Nos. 9, 10	—	—	.323"	—
Total Thickness	2.328"	2.133"	3.230"	2.424"
Spring Clip and Type	4-Clinch	3-Bolt	2-Bolt	4-Bolt
Mounting;				
Front	Plain Bushing	Plain Bushing	Plain Bushing	Plain Bushing
Rear	Threaded "H" Shackle	Plain Shackle	Plain Shackle	Plain Shackle
Axle Housing	2 U-Bolts	2 U-Bolts	2 U-Bolts	2 U-Bolts

AUXILIARY SPRINGS—1½ Ton Trucks	
Number Leaves	6
Leaf Thickness	.323"
Total Thickness	1.938"
Length	31" Between Bracket Centers
Width	2½"

Section 5

BRAKES

The braking system of all trucks combines hydraulically operated service brakes with a mechanically operated parking brake. Fundamentally, the braking system of all the trucks is the same. However, due to variance in the brake lining sizes, wheel brake drum sizes, and frame design there are several differences in the braking systems. Fig. 1 shows the brake construction.

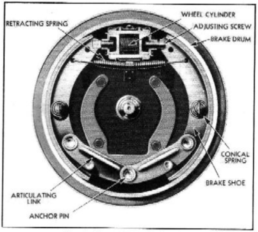

Fig. 1—Front Brake Mechanism

In order to thoroughly understand the operation of the hydraulic brake system, it is necessary to have a good knowledge of the various parts and their functions and to know what takes place throughout the system during the application and release of the brakes.

MAIN CYLINDER

The piston in the main cylinder, Fig. 2, receives mechanical pressure from the push rod and exerts pressure on the fluid in the lines, building up the hydraulic pressure which moves the wheel cylinder pistons. The primary cup is held against the piston by the piston return spring which also retains the return valve against its seat. The spring maintains a slight pressure in the lines and in the wheel cylinders to prevent the possible entrance of air into the system. The secondary cup, which is secured to the opposite end of the piston, prevents the leakage of fluid into the rubber boot. Holes in the piston head allow the fluid to flow from the annular space around the piston into the space between the primary cup and the check valve thereby keeping sufficient fluid in the lines at all times. Holes in the valve cage allow the fluid to flow through the cage and around the lip of the rubber valve cup and out into the lines during brake application. When the brake is released the valve is forced off its seat, permitting the fluid to return to the main cylinder. The push rod assembly is held in the opposite end of the housing by means of a snap ring. The rubber boot that fits around the push rod and over the end of the housing prevents dirt or any other foreign matter from entering the main cylinder, Fig. 2.

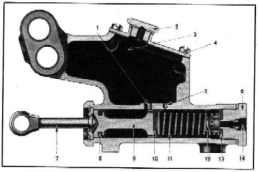

Fig. 2—Main Cylinder Cross Section

1—Inlet
2—Filler Plug
3—Reservoir
4—Housing Cover
5—Compensating Port
6—End Plug
7—Pedal Link
8—Piston Cup—Secondary
9—Piston
10—Piston Cup—Primary
11—Spring
12—Valve
13—Valve Seat
14—Outlet

WHEEL CYLINDER

The wheel cylinder (see Fig. 1) contains two pistons, the purpose of the two pistons being to distribute the pressure evenly to each of the two brake shoes. The rubber piston cups maintain pressure on the pistons and prevent the leakage of fluid past the pistons. The adjusting covers serve two purposes: first, to cover the ends of the cylinder and prevent the entrance of dirt and foreign matter into the cylinder, and second, serve as a means of adjusting the brake shoes to the proper drum clearance, being threaded to receive the slotted adjusting screws which fit the webs of the brake shoes.

SEQUENCE OF OPERATION

As pressure is applied to the brake pedal and is transmitted from the push rod to the piston in the main cylinder, the primary cup closes the compensating port and fluid is forced through the holes in the valve cage, around the lip of the rubber valve cup, into the pipe lines and into the wheel cylinders. This pressure forces the pistons in the wheel cylinders outward, expanding the brake shoes against the drums. As the pedal is farther depressed, higher pressure is built up within the hydraulic system, causing the brake shoes to exert greater force against the brake drums. Fig. 1.

As the pedal is released, the hydraulic pressure is relieved and the brake shoe retracting springs draw the shoes together, pressing the wheel cylinder pistons inward and forcing the fluid out of the wheel cylinders back into the lines toward the main cylinder. The piston return spring in the

main cylinder returns the piston to the pedal stop faster than the brake fluid is forced back into the lines, creating a slight vacuum in that part of the cylinder ahead of the piston. This vacuum causes a small amount of fluid to flow through the holes in the piston head, past the lip of the primary cup and into the forward part of the cylinder. This action keeps the cylinder filled with fluid at all times, ready for the next brake application. As fluid is drawn from the space behind the piston head it is replenished from the reservoir through the inlet port. When the piston is in a fully released position, the primary cup clears the compensating port, allowing excess fluid to flow from the cylinder into the reservoir as the brake shoe retracting springs force the fluid out of the wheel cylinders.

SERVICE OPERATIONS

To properly maintain the braking system, servicemen must appreciate that a thorough knowledge of the system, absolute cleanliness, and careful workmanship are very important. Absolute cleanliness is necessary in that, any foreign matter in the system will tend to clog the lines, ruin the rubber cups of the wheel and main cylinders, and cause inefficient operation or even failure of the braking system; dirt or grease on a brake lining will cause that lining to take effect first on brake application and fade out on heavy brake application. Careful workmanship will result in a well done job.

BLEEDING THE HYDRAULIC BRAKE SYSTEM

The hydraulic brake system must be bled whenever a pipe line has been disconnected, or when a leak has allowed air to enter the system. A leak in the system may sometimes be evident through the presence of a "spongy" brake pedal. Air trapped in the system is compressible, and does not permit all pressure applied to the brake pedal to be transmitted through to the brake shoes. The system must be *absolutely* free from air at all times.

The longest pipe line of the brake system should be bled first. The proper sequence for bleeding is: left rear, left front, right rear, and lastly, right front. During bleeding operations the main cylinder must be kept at least half full of hydraulic brake fluid. The main cylinder filler, (J-713C) Fig. 3 automatically maintains the correct fluid level in the main cylinder during bleeding.

TO BLEED THE HYDRAULIC BRAKE SYSTEM

Carefully clean all dirt from around the main cylinder filler plug.

Remove filler plug, install adapter and automatic filler. Open automatic valve in the filler.

Remove bleeder valve screw. Attach bleeder drain, (J-747) Fig. 4, keeping the end of the drain hose below the surface of the fluid in the jar.

Unscrew bleeder valve in wheel cylinder ½ to ¾ turn.

Depress the foot pedal by hand, allowing it to return slowly. Continuing this pumping action forces the fluid through the lines and out at the bleeder drain, carrying with it any air in the system.

When bubbles cease to appear at the end of the

Fig. 3—Filling Main Cylinder Reservoir

bleeder drain hose in the jar and the stream is a solid fluid mass, tighten the bleeder valve and remove the drain hose.

Replace and tighten the screw at the end of the bleeder valve.

After bleeding operation has been completed at all wheels, fill the main cylinder reservoir approximately full, and replace the filler plug.

NOTE—Fluid withdrawn in the bleeding operation should not be used again.

HYDRAULIC BRAKE FLUID

As there are several general classifications of Hydraulic Brake Fluids on the market, care should be taken to make certain that the fluid being used will not injure the brake parts. Some brake fluids may have a rather severe action on the rubber parts, causing them to become sticky, preventing proper piston action or, due to expansion of the rubber parts, cause them to lose their sealing qualities. Other types of fluid may cause vapor lock or, due to extreme thinness, leak past the rubber cups in the wheel cylinders and saturate the brake linings.

G. M. Hydraulic Brake Fluid-Super No. 9 can be used with certainty that it will not have a damaging effect upon the rubber cups in the brake system.

In the event that improper fluid has entered the system, it will be necessary to:

1. Drain the entire system.
2. Thoroughly flush out the system with clean alcohol, 188 proof, or a hydraulic brake system cleaning fluid, known to the industry as Declene.
3. Replace all rubber parts of the system.
4. Refill with proper Hydraulic Brake Fluid.

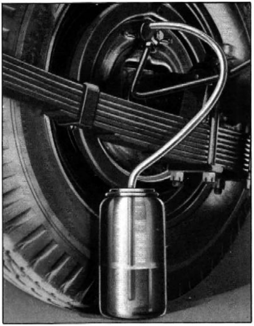

Fig. 4—Bleeding Brake System at Wheel Cylinder

HYDRAULIC BRAKE TUBING

The hydraulic brake tubing is a double layer flexible steel, copper-coated, tin-plated tubing which resists corrosion and also stands up under the high pressures which are developed when applying the brakes.

The important thing in connection with making up hydraulic brake pipes is the proper flaring of the ends of the tubing for the compression couplings. Unless the tubing is properly flared the couplings will leak and the brake will become ineffective.

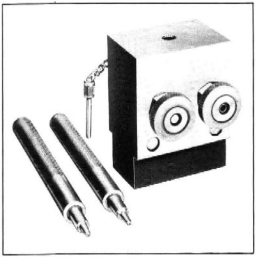

Fig. 5—Hydraulic Brake Tubing Flaring Tool

This safety steel tubing must be double-lap flared at the ends in order to produce a strong, leak-proof joint.

The brake tube flaring tool shown in Fig. 5 is used to form the double-lap flare.

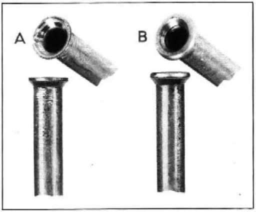

Fig. 6—Single and Double-Lap Flare on Tubing End

Fig. 6 shows two pieces of tubing—one with a single-lap flare ("A") and the other with the double-lap flare ("B"). It will be noted that the single-lap flare split the tubing while the one shown in "B" has a heavy, well-formed joint.

DIRECTIONS

1. Cut the tubing to the desired length, using tube cutter KMO3 to prevent flattening the tubing. Square off the end with a fine-cut mill file, then ream the sharp edges with the reamer blade provided on the tube cutter. (Fig. 7.)

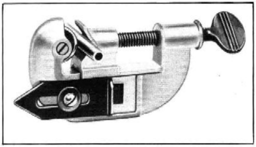

Fig. 7—Cutting Hydraulic Brake Tubing

2. Place new compression coupling nuts on the tubing. Dip end of tubing to be flared in hydraulic brake fluid. This lubrication results in a better formation of the flare. Loosen the clamping nuts on the flaring tool, KMO J-1280-1, and insert finished end of the tubing in the channel of the die until it bears against the stop pin, Fig. 8.

   Tighten the clamping nuts by hand and place the fixture in a bench vise. Then tighten down the clamping nuts firmly with a wrench

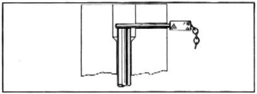

Fig. 8—Installing Tubing to Proper Depth

and remove the stop pin from the die. The tubing is now firmly gripped in the die and ready for the first flare forming operation.

3. Using the flare forming tool having the concave die, J-1280-2, insert the forming tool in the die and strike firm blows, using a one pound hammer, until the shoulder of the tool contacts the top of the die. The cross section drawing (Fig. 9) shows the first step in forming the double-lap flare.

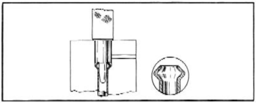

Fig. 9—First Flaring Operation

4. Next, use the flare forming tool, J-1280-3, having the 45 degree die at its lower end. Insert the tool in the die and strike firm blows, using a one pound hammer, until the shoulder of the tool contacts the top of the die. The cross section drawing, Fig. 10, shows the second and final forming operation in making a double-lap flare.

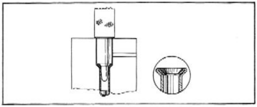

Fig. 10—Finish Flaring Operation

HYDRAULIC BRAKE ADJUSTMENT

Chevrolet hydraulic brakes can be adjusted without the removal of the wheels as all brake flange plates have openings with spring snap covers to simplify brake adjustment.

TOE-BOARD CLEARANCE

Toe-board clearance very seldom needs to be adjusted. The pedal stop, located in the brake main cylinder, is permanent. Before attempting to adjust this stop, be certain that the pedal returns to the fully released position freely, with no binding, and that the pedal retracting spring has not lost its tension.

1. Loosen the check nut on the rear of the clevis on the main cylinder push rod.
2. Remove clevis pin and turn the clevis attached to the main cylinder push rod, Fig. 11, in the proper direction to secure ¼" toe-board clearance—measurement being taken between pedal arm and underside of toe-pan.
3. Tighten the check nut against the clevis.

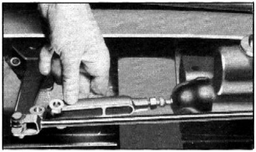

Fig. 11—Adjusting Pedal Toe-Board Clearance

BRAKE SHOE ADJUSTMENT

½ and ¾ Ton Trucks

1. Raise the truck and place stand jack front and rear so that all four wheels rotate freely.
2. Disconnect the parking brakes. This precaution should be taken to eliminate the possibility of the brake shoes dragging the drum due to misadjustment of the parking brakes.
3. Remove the adjusting hole covers and insert a screwdriver through the adjusting hole and engage the teeth on the adjusting cover of the wheel cylinder, Fig. 12.

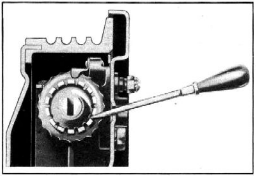

Fig. 12—Adjusting Brakes Through Slot in Flange Plate

Turn the adjusting cover in a clockwise direction looking at the end of the cylinder, until the shoes cause a slight drag on the brake drum.

4. When the "drag" condition is reached, turn the adjusting cover back, the opposite direction, four (4) notches.

BRAKE SHOE ADJUSTMENT

1½ Ton Trucks

The adjustment of the front brakes on the 1½ ton trucks is the same as for the ½ and ¾ ton trucks with the exception that the wheel cylinder adjusting covers are backed off five (5) notches instead of four (4).

To adjust the rear brakes on these trucks use a ⅝" open end wrench to turn the adjusting pinion.

1. Turn the adjusting pinion in a clockwise direction until the shoe causes a slight drag on the brake drum, as shown in Fig. 13.

2. Turn the adjusting pinion back in the opposite direction ¾ of a turn to provide running clearance.

The backing-off of the adjusting cover, the specified number of notches will be indicated by a faint click of the cover lock spring as the cover is turned. This backing-off of the adjusting cover moves the brake shoe away from the drum to insure proper running clearance of the shoes in the drum.

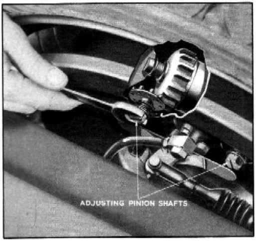

Fig. 13—Adjusting 1½-Ton Truck Rear Brakes

PARKING BRAKE ADJUSTMENT

½ and ¾ Ton Trucks

The parking brake adjustment should be checked each time the hydraulic service brakes are adjusted.

When making a parking brake adjustment the service brakes must be properly adjusted first as a base for adjusting the parking brakes:

1. Set the parking brake lever in the fully released position.

2. Loosen the check nuts at the cable ends.

3. Pull the cables out of the conduit by hand until a positive stop is felt. While holding the cable in this position, adjust the check nuts against the clevis plates. Then tighten the check nuts securely.

1½ Ton Trucks

The parking brake adjustment should be checked each time the Hydraulic Service Brakes are adjusted.

When making a parking brake adjustment, the service brakes must be properly adjusted first as a base for adjusting the parking brakes.

1. Set the parking brake lever in the fully released position.

2. Remove the cotter pin and clevis pin from the pull rods. Loosen the check nut.

3. Pull the cables out of the conduit by hand until a positive stop is felt. While holding the cable in this position, turn the clevis until the hole in the clevis registers with the hole in the rod eye on the cable. Replace the clevis pin and cotter pin. Tighten the check nut securely.

4. Check the brakes for freedom from drag or unequal braking. If further adjustment is necessary to eliminate either shoe drag or unequal braking, proceed as outlined in 2 and 3 above. Never attempt to eliminate shoe drag by making adjustments at the wheel cylinder, as this would result in improper running clearance between shoe and drum.

BRAKE LININGS

Inspection

After removal of the brake drums and before disassembly of the shoes from the flange plate, all linings should be inspected for wear, improper alignment causing uneven wear and oil or grease on linings. If any of these conditions exist, it will be necessary to replace or reline the shoes. If in checking the lining it is noticed that they have the appearance of being glazed, this is a normal condition with the hard type lining used. Do not use a wire brush or any abrasive on the lining to destroy this glazed surface as it is essential for proper operation.

Satisfactory performance can be obtained by replacing only the forward shoes when the reverse shoe linings do not show excessive wear. Tests have shown that in most cases the reverse lining will outlast two sets of forward linings. This is true of both front and rear wheel brakes.

Shoes should be changed in sets; that is, both forward shoes on the front wheels, or both forward and reverse shoes on front wheels. The same is true on the rear wheels.

BRAKE SHOE REMOVAL

½ and ¾ Ton Trucks

1. Jack up the truck and remove wheel and brake drum.

2. Install wheel cylinder clamp, Fig. 14 (J-718C) to keep the wheel cylinder pistons in place and prevent leakage of brake fluid while replacing shoes.

3. Remove brake shoe retracting spring with special pliers, KMO 142, Fig. 15.

4. Remove conical guide springs.

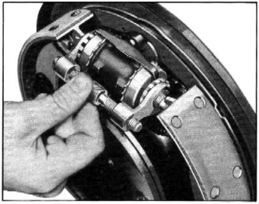

Fig. 14—Installing Brake Wheel Cylinder Clamp

5. Remove brake shoe anchor pin lock and pin. On rear brakes—remove toggle lever, eccentric bolt and nut from the rear brake shoe.
6. Remove articulating link friction spring pin lock, pin and spring. Disassemble articulating links from shoes by removing pin lock and pin.

The illustration, Fig. 16, shows a layout of the ½ and ¾ ton truck rear brake parts.

1½ Ton Trucks

The removal and replacement of the brake shoes of the 1½ ton trucks is identical with that of the ½ and ¾ ton trucks except for slight variations in the design of the hook-up.

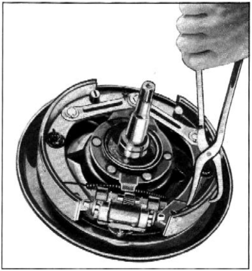

Fig. 15—Removing Brake Shoe Retracting Spring

1. It is necessary to remove the wheels and brake drums with the wheel hubs to replace brake linings, necessitating the readjustment of the wheel bearings.
2. The operating mechanism of the parking brakes at the rear wheels on the trucks is a lever and link assembly. This lever and link assembly is attached to the rear brake cable on the outside of the brake flange plate. The lever on the in-

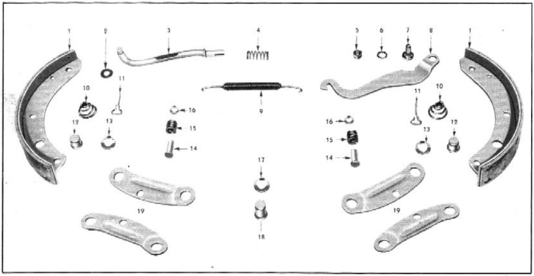

Fig. 16—Layout of Rear Wheel Brake Parts—½ and ¾-Ton Trucks

1—Brake Shoe and Lining
2—Parking Brake Lever Extension Washer
3—Parking Brake Lever Extension
4—Parking Brake Lever Extension Spring
5—Parking Brake Lever Anchor Bolt Nut
6—Parking Brake Lever Anchor Bolt Lockwasher
7—Parking Brake Lever Anchor Bolt
8—Parking Brake Lever
9—Brake Shoe Retracting Spring
10—Brake Shoe Guide Spring
11—Brake Shoe Guide Spring Pin
12—Articulating Link Pin
13—Articulating Link Pin Lock
14—Articulating Link Friction Spring Pin
15—Articulating Link Friction Spring
16—Articulating Link Friction Spring Pin Lock
17—Anchor Pin
18—Anchor Pin Lock
19—Articulating Link

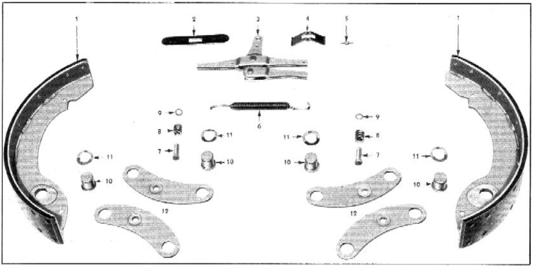

Fig. 17—Layout of Rear Wheel Brake Parts—1½-Ton Trucks

1—Brake Shoe and Lining
2—Camshaft Hole Cover
3—Parking Brake Link Assembly
4—Brake Camshaft Hole Cover Spring
5—Parking Brake Lever Hole Cover Spring Pin
6—Brake Shoe Retracting Spring
7—Brake Shoe Articulating Link Friction Spring Pin
8—Brake Shoe Articulating Link Friction Spring
9—Brake Shoe Articulating Link Friction Spring Pin Lock
10—Brake Shoe Articulating Link Pin
11—Brake Shoe Articulating Link Pin Lock
12—Brake Shoe Articulating Link

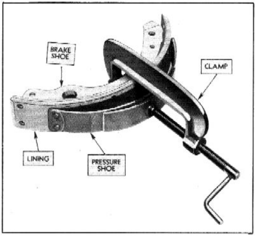

Fig. 18—Installing Brake Lining Clamp

side, as it is actuated by the parking brake lever to set the brakes, moves the links outward expanding the brake shoes. Each link has a support at its outer end.

3. Each brake shoe of the rear brakes has an individual anchor pin.

The illustration, Fig. 17, shows a layout of the 1½ ton truck rear brake parts.

BRAKE SHOE RELINING

1. Remove the rivets, using the deliner punches in a brake shoe relining machine.
2. Wash the shoes in cleaning solvent, then buff them on a wire buffer.

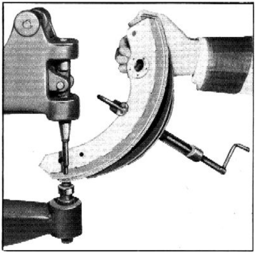

Fig. 19—Riveting Brake Lining to Shoe

3. Install new lining in place on shoe and rivet two holes at center.
4. In order to eliminate air pockets between lining and shoe which might cause uneven contact or squeaky brakes, a brake shoe lining clamp should be used to force the lining against the shoe, Fig. 18.
5. After the end holes in the lining and shoe are in alignment, the rivets may be installed in both ends, Fig. 19.
6. Remove the clamp and install the remaining rivets.

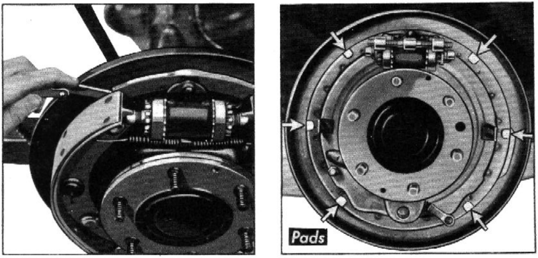

Fig. 20—Checking Alignment of Brake Shoes with Flange Plate

BRAKE SHOE REPLACEMENT

½ and ¾-Ton Truck Rear Brakes

1. Reassemble toggle lever to new shoe assembly, making sure that the high side of the eccentric on the bolt is towards the brake shoe facing. A flat has been ground on the bolt head to indicate the high side of the eccentric. (This eccentric bolt is used to adjust the clearance between the parking brake extension and the toggle link.)
2. Reassemble articulating links, pins, friction springs, and locks to new brake shoes and assemble shoes to anchor plate.
3. On rear brakes, hook-up toggle lever to parking brake cable.
4. Place spring on parking brake extension link and line up slot of the link so that it will straddle toggle lever.
5. Install conical guide springs, brake shoe retracting spring, and remove wheel cylinder clamp.
6. Check with a .002" feeler to make certain the shoes are against the pads on the brake flange plate, Fig. 20. If the shoes do not touch all pads it may be necessary to bend the anchor plate to correct this condition.
7. When replacing rear brake drums, make sure the tongue in the web section of the drum extends into the drain hole in the axle shaft flange. This serves as a positive locating point to line up the hole in the drum with the drain hole in the axle shaft flange.

Whenever a brake drum has been removed for replacement of brake shoes or for shoe adjustment, it will be necessary to depress the foot pedal firmly to align the brake shoe articulating links before making brake adjustment.

PARKING BRAKE TOGGLE LEVER ADJUSTMENT

Whenever new rear brake shoes are installed on the ½ ton and all ¾ ton trucks, it is necessary to adjust the toggle lever with the emergency brake extension link, by means of the eccentric bolt. This can only be done correctly AFTER the hydraulic service brake adjustment has been made and the brake shoes are in a fully released position.

1. Remove brake drum and loosen eccentric bolt lock nut, Fig. 21.

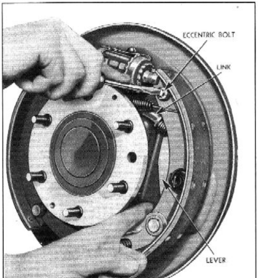

Fig. 21—Adjusting Rear Brake Toggle

2. Hold the toggle lever against the shoe and turn the eccentric bolt until there is only a slight clearance between the lever and the bottom of the slot in the parking brake extension link.
3. Tighten eccentric bolt lock nut and again check for clearance.
4. Replace brake drum, adjust parking brakes and road-test car for performance.

½ and ¾-Ton Truck Front Brakes

The front brake shoes on ½ and ¾ ton trucks are installed in the same manner as on the rear with the exception that the front brakes do not have a parking brake toggle link.

1½-Ton Truck Brakes

1. Reassemble articulating links, pins, friction springs, and locks to new brake shoes and assemble shoes to anchor plate.
2. Check fit of shoe in the brake shoe guide riveted to the anchor plate. The shoe should be free without excessive side movement.
3. Install brake shoe retracting spring and remove wheel cylinder clamp.
4. Replace wheels and hubs and adjust the wheel bearings as outlined in the Front and Rear Axle Sections.
5. Adjust brakes as previously outlined under Wheel Cylinder and Emergency Brake Adjustments.

Brake Drums

The brake drums are attached to the wheel hubs by serrated bolts. These bolts are also used for mounting the wheels to the hubs.

To remove a brake drum, drive out the serrated bolts and remove the drum.

When replacing a drum, the gasket between the inside of the brake drum and oil deflector should be coated with heavy shellac or paint on both sides to prevent oil from leaking on to the braking surface of the drum. The small hole in the gasket and the channel in the oil deflector must be lined up with the oil relief hole in the drum. Insert six new bolts through the oil deflector, brake drum and hub flange, then place the assembly on the riveting fixture with the threaded end of the bolt passing into the hole in one of the supports. Drive the bolts into place, solidly. Place the assembly on the fixture as shown in Fig. 22 and peen the shoulder of the bolt into the chamfer in the hub flange. It is good practice to turn the peening tool after each hammer blow to prevent damage to the tool.

NOTE—The above operation is very important from a safety standpoint.

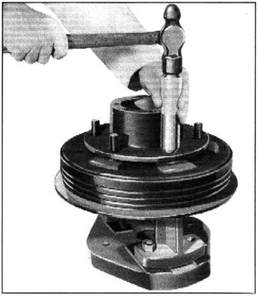

Fig. 22—Peening Hub and Drum Bolts

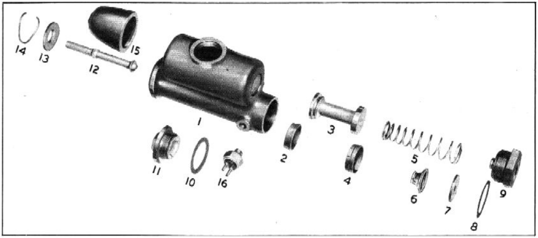

Fig. 23—Layout of Main Cylinder Parts

1—Main Cylinder Body
2—Secondary Piston Cup
3—Piston
4—Primary Piston Cup
5—Return Spring
6—Outlet Valve
7—Valve Seat
8—End Plug Gasket
9—End Plug
10—Filler Plug Gasket
11—Filler Plug
12—Pedal Link
13—Link Retainer
14—Snap Ring
15—Dust Boot
16—Stop Light Switch

MAIN CYLINDER OVERHAUL

Disassembly

1. Remove the end plug and valve seat washer.
2. Remove the valve seat washer from the button on the end plug, Fig. 25.
3. Remove the valve assembly and spring.
4. Remove the main cylinder boot.
5. Remove the pedal stop snap ring with a screwdriver and remove the pedal stop assembly.
6. Remove the piston with the secondary cup.
7. Remove the primary cup.

After all parts have been removed from the main cylinder, they should be washed in CLEAN ALCOHOL. Special care should be taken to make sure that the compensating port in the main cylinder housing, and the bleeder holes of the piston are clean. BEFORE WASHING PARTS, HANDS MUST BE CLEAN. DO NOT WASH HANDS IN GASOLINE OR OIL. BEFORE CLEANING HYDRAULIC BRAKE CYLINDER PARTS, USE SOAP AND WATER TO CLEAN HANDS.

The illustration, Fig. 23, shows a layout of the main cylinder parts.

Inspection

Inspect the cylinder bore to make sure it is smooth.

Inspect primary and secondary cups, valve and valve seat for damage or swelling. Replace when necessary. Swelling of the rubber parts is due to the use of improper brake fluid, or the washing of the parts in gasoline, or kerosene.

NOTE—The primary cup of the main cylinder has a brass support ring vulcanized in its base to prevent the primary cup from imbedding in the bleeder holes during braking action.

Check piston fit in the cylinder bore, see Fig. 24. The clearance between the piston and wall of the cylinder should be from 1 to 5 thousandths of an inch.

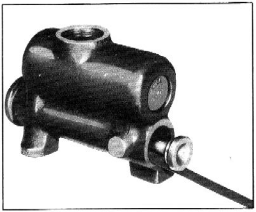

Fig. 24—Checking Main Cylinder Piston Fit

Check the clearance between the edge of the primary cup and the center of the compensating port, Fig. 25. In order to check this clearance accurately the main cylinder must be partially assembled as follows:

1. Install pedal stop assembly and lock in place with snap ring.
2. Assemble secondary cup on piston and install assembly in housing. Place the primary cup in the housing, with the flat side of the cup against the piston.
3. Push the piston and cup against the pedal stop and check the clearance between the edge of the primary cup and the center of the compensating port. This clearance should be a minimum of 35 thousandths of an inch. This check is made easiest by using a wire inserted through the reservoir of the housing and extending into the piston chamber, Fig. 25. If the clearance is less than 35 thousandths of an inch, the primary cup must be replaced with a new one.
4. After this clearance has been checked, the main cylinder must be again completely disassembled and reassembled according to the following directions.

Reassembly

Whenever a hydraulic brake master cylinder is being overhauled for any purpose, care must be taken to reassemble the valves and seats correctly. Improper assembly of the check valve seat rubber washer will result in its distortion. When the check valve seat is distorted, there will be no check valve seal and there will be a loss of brake pedal travel and the pedal must be depressed or pumped one or more times before actual car braking occurs.

In order to minimize the chances of distorting the check valve seat the following method of assembly is recommended:

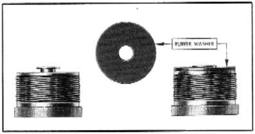

Fig. 25—Valve Seat Washer Assembly

1. Dip a new check valve seat washer in genuine hydraulic brake fluid, and assemble over the button on the end of the end plug, Fig. 25. Assemble a new gasket over the end plug and screw the end plug, valve seat washer and gasket into the main cylinder housing. Tighten the nut securely.
2. Inspect the valve seat washer through the push rod end of the housing to make sure the washer is properly seated.
3. Dip the rubber cups and valves in hydraulic brake fluid.
4. Install the valve assembly from the push rod end of the main cylinder.
5. Install piston spring.

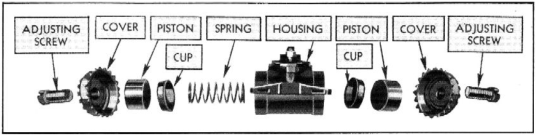

Fig. 26—Wheel Cylinder Parts Layout

6. Place the primary cup in the housing, with the cupped side against the spring.
7. Assemble secondary cup to the piston and install assembly to the housing so that the bleeder hole end of the piston will be against the flat side of the primary cup.
8. Install the pedal stop assembly and lock in place with the snap ring.
9. Install the rubber pedal stop boot, making sure this seal is tight on the housing and the vent hole in the boot is at the bottom. This seal must be tight to keep water and other foreign matter from entering the main cylinder through the pedal stop.
10. After the main cylinder has been assembled to to the chassis, it should be filled with genuine G. M. Super No. 9 hydraulic brake fluid, and all pipe lines at each wheel cylinder bled.

WHEEL CYLINDER OVERHAUL

Removal

In order to remove a hydraulic brake wheel cylinder the truck must be jacked up, the wheel and brake drum removed, the brake system wheel cylinder pipe or hose disconnected at the wheel, and the brake shoe retracting spring disconnected from the brake shoes. Two cap screws which hold the cylinder to the brake flange plate must be removed before the cylinder can be taken from the flange plate.

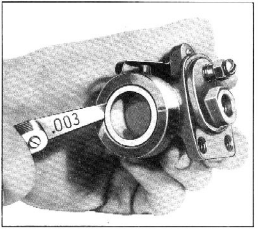

Fig. 27—Checking Wheel Cylinder Piston Fit

Disassembly

1. Remove the cylinder adjusting covers.
2. Remove the pistons, rubber cups and spring.
3. Wash all parts in CLEAN ALCOHOL. WASH YOUR HANDS BEFORE WASHING THE PARTS IN ALCOHOL. HANDS MUST BE CLEAN.

The illustration, Fig. 26, shows a layout of the wheel cylinder parts.

Inspection

1. Inspect the cylinder bore, making sure that it is smooth. A scored or damaged cylinder must be replaced.
2. Check rubber cups for damage or swelling due to improper brake fluid. Replace the cups when necessary. Improper brake fluid will cause the cups to swell as much as 40 per cent.
3. Check the fit of the piston in the cylinder bore, using a feeler gauge, Fig. 27. This clearance should be from 2 to 4 thousandths of an inch.

Reassembly and Replacement

1. Dip pistons and rubber cups in brake fluid.
2. Place the spring in the center of the housing, the rubber cups at each end of the spring, with their open face to the spring and the flat face of the cup flush with the piston.
3. Replace the adjusting covers with the adjusting screws in place.
4. Reassemble the wheel cylinder to the flange plate, connect the wheel cylinder pipe or hose and replace the brake shoe retracting spring, brake drum, and the wheel.

After a wheel cylinder has been overhauled and replaced, all hydraulic brake lines must be bled.

WHEEL CYLINDER SIZES AND IDENTIFICATION

Each brake has a specified wheel cylinder, depending on the area of the brake shoe. It is important that *only the specified wheel cylinder be used* at that wheel.

	Front	Rear
½ and ¾ Ton Truck	1¼"	1-3/16"
1½ Ton Truck	1¼"	1½"

The above sizes are stamped under the adjusting cup lock spring on each cylinder housing. The numbers stamped on the housing indicate the size of the piston.

BRAKE CABLES

1½ ton truck models use right and left parking brake cables. The left hand brake cable may be identified by a string tracer woven under the cable wire shield.

On the ½ ton truck the parking brake cables are longer than are the cables on any of the other models. This provides for the attachment of the cable to the pull rod at the pulleys on the frame cross member.

ALCOHOL FOR CLEANING HYDRAULIC BRAKE PARTS

We cannot recommend using any alcohol for cleaning the hydraulic brake system which is less than 188 per cent proof because weaker alcohols contain 10 per cent or more of water. There are some radiator antifreezes that are even 200 per cent proof.

In any case where mineral oil has entered the hydraulic brake system and is being flushed out with alcohol, in order to clean out the mineral oil, it is best that the flushing should employ generous quantities of alcohol and the flushing be conducted in a vigorous manner. Mineral oil is not soluble in alcohol. The two will mix mechanically, and for this reason a rather large quantity of alcohol, with considerable pressure behind it, must be used. Alcohol that has been used for cleaning out a system containing any mineral oil should never be used again.

BRAKE TROUBLES AND REMEDIES

Symptom	Probable Remedy
Brake Pedal	
1. Brake pedal "spongy."	1. Air in lines, bleed brakes.
All Brakes Drag	
1. Mineral oil in system.	1. Thoroughly wash out all lines and cylinders, and replace all rubber parts.
2. Improper toe-board clearance.	2. Adjust toe-board clearance. See Instructions.
3. Dirt in main cylinder compensating port.	3. Remove main cylinder and clean thoroughly. See Instructions.
One Brake Drags	
1. Loose wheel bearing.	1. Adjust wheel bearing.
2. Weak retractor spring.	2. Replace spring.
3. Brake shoes adjusted too close to drum.	3. Readjust brakes according to instructions.
Loose Brakes	
1. Normal lining wear.	1. Readjust brakes according to instructions.
2. Brake lining worn out.	2. Replace linings and readjust.
3. Fluid low in main cylinder.	3. Fill main cylinder and bleed all brake lines.
Brakes Uneven	
1. Oil on lining.	1. Thoroughly clean brake mechanism and install new lining.
2. Shoes tight on brake anchor.	2. Remove brake drum and free up shoes on anchor.
3. Tires improperly inflated.	3. Inflate tires according to specifications.
4. Spring center bolt sheared and spring shifted on axle.	4. Replace spring center bolt, relocate spring on axle.
Excessive Pedal Pressure, Poor Brakes	
1. Oil on lining.	1. Thoroughly clean brake mechanism and install new lining.
2. Full area of lining not contacting drum.	2. Sand shoes so linings contact drum properly.
3. Scored brake drum.	3. Turn drum, or replace it. If lining is badly scored, it should also be replaced.

TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling brakes:

Tool Number	*Description*
J-713C	Brake Main Cylinder Filler
J-747	Brake Bleeder Tube
J-718C	Brake Cylinder Clamps (Set of four)
KMO 142	Brake Spring Pliers
J-554	Hub Bolt Peening Tool
J-1280	Brake Tube Flaring Tool
KMO-3	Tube Cutter

BRAKE SPECIFICATIONS

SERVICE BRAKE TYPE....4-Wheel Hydraulic

HAND BRAKE TYPE.....Mechanical Linkage to Rear Brake Shoes

MAIN CYLINDER
- Mounting................L.H. Frame Side Rail
- Size
  - ½ Ton ....1″
  - ¾ and 1½ Ton.......................1¼″

FRONT WHEEL CYLINDER
- Size
  - All ....1¼″

REAR WHEEL CYLINDER
- Size
  - ½ and ¾ Ton .... 1-3/16″
  - 1½ Ton .... 1½″

BRAKE DRUM DIAMETER
- Front
  - ½ and ¾ Ton..........................11″
  - 1½ Ton ....14″
- Rear
  - ½ and ¾ Ton..........................11″
  - 1½ Ton ....16″
- Regrinding Limits...........125″ on Diameter

BRAKE LINING—FRONT
- Width
  - ½ and ¾ Ton..........................1¾″
  - 1½ Ton ....2″
- Length
  - ½ and ¾ Ton....................11-5/16″
  - 1½ Ton ....14⅛″
- Thickness
  - ½ and ¾ Ton................. .187″—.194″
  - 1½ Ton Conventional........... .243″—.250″

BRAKE LINING—REAR
- Width
  - ½ and ¾ Ton.........................1¾″
  - 1½ Ton ....3″
- Length
  - ½ and ¾ Ton.....................11-5/16″
  - 1½ Ton ....17-37/64″
- Thickness
  - ½ and ¾ Ton................. .187″—.194″
  - 1½ Ton Conventional........... .243″—.250″

AREA—BOTH AXLES
- Service Brakes
  - ½ and ¾ Ton.................158¼ Sq. In.
  - 1½ Ton ....330¼ Sq. In.
- Hand Brakes
  - ½ and ¾ Ton..................79⅛ Sq. In.
  - 1½ Ton ....214¾ Sq. In.

MASTER CYLINDER
- Fluid Level ....Check Periodically
- Brake Fluid.......DuPont or Delco Super No. 9
- Piston Clearance .... .001″—.005″

WHEEL CYLINDER
- Piston Clearance .... .002″—.004″

FRONT SHOE ADJUSTMENT

From slight drag on drum back off 4 notches, adjusting screw at each end of wheel cylinder.

REAR SHOE ADJUSTMENT

From slight drag on drum back off 2/3 turn or 4 sides of hexagon head of adjusting bolt, adjusting bolt outside of shoe backing plate at each end of wheel cylinder.

HAND BRAKE ADJUSTMENT

With brake lever fully released, adjust clevis on end of pull rod to engage hole in idler lever when cables are pulled out of conduits by hand until a positive stop is felt.

PEDAL ADJUSTMENT
- Pedal to Toe-Board Clearance.............¼″

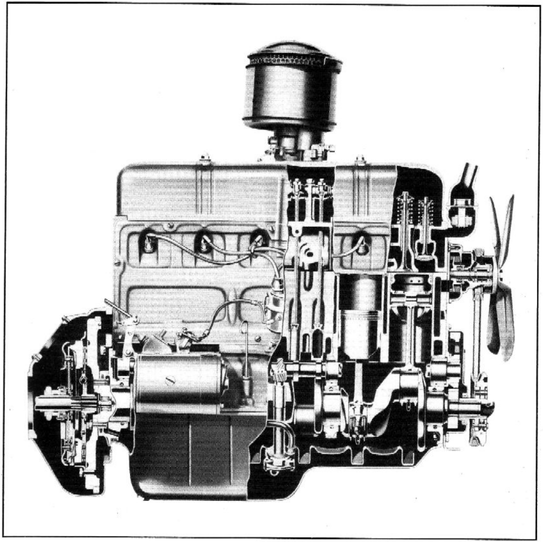

Fig. 1—Engine—Cross-Section

ENGINE

The engine is a six cylinder valve-in-head type, equipped with a counterbalanced crankshaft.

The displacement of this engine is 235.5 cubic inches, it develops 93 horsepower at 3100 revolutions per minute.

Maximum torque is 192 foot-pounds. The illustration Fig. 1 shows a view of the engine assembly in cross-section.

Engine Removal from Chassis

1. Drain radiator and cylinder block. Remove the hood and hood side panels.
2. Remove the radiator, front end sheet metal, and fenders as a unit as described in Section 11 of this manual.
3. Remove the battery cable and ammeter wire from the starter switch terminal. Tape the end of the battery wire to prevent the possibility of shorts. Remove the coil wire from the center terminal of the reversing switch. Remove the two screws which mount the coil and lay the coil with the electrolock cable attached on top of dash.
4. Disconnect the gasoline line from the fuel pump.
5. Remove the right engine side pan.
6. Remove the generator and field wires from the generator. Remove the wires from the horn.

7. Disconnect the choke and throttle control cables from the carburetor. Disconnect the line to the oil pressure gauge.
8. Remove the two exhaust pipe to manifold bolts and then remove the left engine side pan.
9. Remove the floor and toe boards.
10. Split the universal joint back of the transmission.
11. Remove the parking brake lever from the side of the transmission case.
12. Disconnect the accelerator rod from the bell crank on the left side of the engine. Remove the three cap screws which mount the clutch and brake pedals to the clutch housing.
13. Remove the starting motor cross shaft by removing the bolts from the brackets and disconnecting the link and spring from the starting motor gear shifter lever.
14. Remove the transmission cover and place a piece of cardboard on top of the transmission to prevent the possibility of dirt falling into it during the following repair operations.
15. Remove the bolts from the rear engine mountings. Remove the front engine mounting.
16. Remove the third cylinder head bolt from the rear on the left side and install the engine lifting eye bolt.
17. Connect a hoist to the eye bolt and raise the engine, clutch and transmission from the chassis as a unit. The engine assembly should then be mounted in an engine repair stand.

REPAIR OPERATIONS

When it becomes necessary to overhaul an engine assembly it should be completely disassembled and all parts thoroughly cleaned before starting the overhaul operations.

In order to simplify the following instructions we will cover the repair of the various parts in the order in which an overhaul job would be performed.

A list of the tools required in connection with a complete engine overhaul will be found at the end of this section.

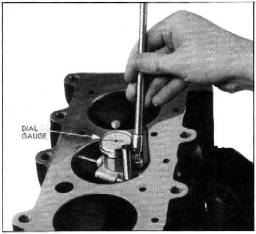

Fig. 2—Checking Cylinder Walls with Dial Gauge

Checking Cylinders

By far the best method to be used in determining the condition of a cylinder in an engine preparatory to reconditioning is the use of a dial gauge such as is shown in Fig. 2.

The dial gauge hand will instantly and automatically indicate the slightest variation in the cylinder bores.

In use, the dial gauge is simply inserted in the cylinder bore, and moved up and down its full length. It is then turned spirally or completely rotated at as many points as may be desired, taking readings at each point. In this manner all variations in the cylinder walls from top to bottom may be determined.

If a master gauge, corresponding with the exact diameter of a standard cylinder bore is used to set the dial gauge, it is easy to determine the oversize piston to use as well as the amount of metal which must be removed from the cylinder walls to make them true.

Cylinder Boring

When it becomes necessary to rebore the cylinders of an engine to install oversize pistons, the instructions furnished by the manufacturer of the equipment used should be carefully followed.

In Chevrolet engines the piston clearance is allowed on the piston and this must be taken into consideration when setting the cutter in the boring bar. The piston to be fitted should be checked with a micrometer, measuring just below the lower ring groove and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston.

If a micrometer is not available to measure the piston, the cylinder should be bored .002" less than the oversize piston to be fitted. For example, when

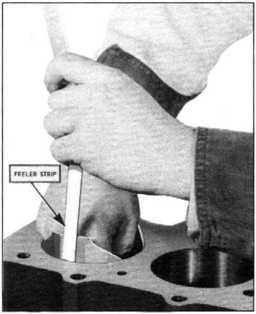

Fig. 3—Fitting Pistons

fitting a .020" oversize piston, the cylinder should be bored .018" oversize.

Cylinder Hone

After a cylinder has been rebored within .002" of the size desired, they should be finished or polished with a cylinder hone.

In operation, the hone is placed into the cylinder bore and expanded until it can just be turned by hand. The hone is then operated, up and down, in the bore until it begins to run free. During this operation kerosene should be used as a cutting fluid to keep the stones of the hone clean. This procedure should be followed until the piston you are fitting can be bushed through the cylinder on a .0015" feeler gauge. THE FEELER GAUGE MUST BE INSERTED VERTICALLY, 90° AROUND PISTON FROM THE PISTON PIN. See Fig. 3.

Pistons

Chevrolet pistons are cast iron granodized, with a slipper skirt with three ring grooves located above the piston pin. They are of unusual design, being cam ground (out of round). This method of grinding the piston compensates for heat expansion along the line of the piston pin bosses.

Chevrolet pistons are furnished in standard sizes as well as .003", .010", .020", .030" and .040" oversizes.

NOTE—Any time a piston is removed from the cylinder it should be examined for carbon on the inside and any carbon deposit removed. This helps keep the engine oil clean.

Fitting Piston Pins

Chevrolet pistons are serviced with the piston pin bushings and piston pins fitted in them. Should it become necessary to install oversize piston pins the following procedure should be carefully followed:

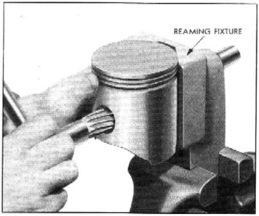

Fig. 4—Reaming Piston Pin Bushings

1. Place the piston pin bushing reaming fixture J-965 in a bench vise. The purpose of the reaming fixture is to make sure the piston pin bushings will be reamed at right angles to the skirt of the piston, assuring proper alignment of the piston in the cylinder.
2. Adjust the expansion reamer for a light cut.
3. Insert the reamer in the piston bushing and start the reamer pilot into the guide in the fixture.
4. Hold the piston in the V-block of the fixture with one hand and turn the reamer handle with the other hand until the reamer has passed through both bushings as shown in Fig. 4.
5. Expand the reamer by easy stages and repeat the reaming operation until the piston pin is fitted.

The proper fit of the piston pin is a "thumb push" fit as shown in Fig. 5.

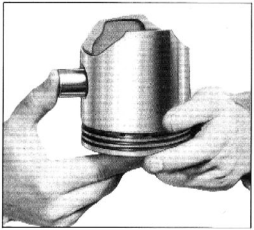

Fig. 5—Checking Piston Pin Fit

Chevrolet piston pins are serviced in standard sizes as well as .003", .005", and .010" oversizes.

Piston Rings

The compression ring used in the Chevrolet engine is designed to control oil consumption during the break-in period. The face of the ring is tapered one-thousandth of an inch. With this design the lower edge of the ring tends to scrape the excess oil from the cylinder wall and acts as an oil control ring until the regular oil control ring is seated (broken-in) in the cylinder. All compression rings are marked with the word "TOP" cast in the upper side of the ring. When installing compression rings make sure the side marked "TOP" is toward the top of the piston.

Piston rings are furnished in standard sizes as well as .005", .010", .015", .020", .030" and .040" oversizes.

To properly fit new piston rings, proceed as follows:

Slip the ring into the cylinder, pressing it down about two inches into the bore with a piston. This will square the ring in the cylinder.

Check the gap between the ends of the ring with a feeler gauge. This should be from .005" to .015".

If the space between the ends of the ring is less than .005", remove the ring and with a fine file dress the ends until proper clearance is obtained. Fit each ring separately.

Carefully remove all particles of carbon from the faces of the ring grooves in the piston, and inspect

the grooves for burrs or nicks that might cause the rings to hang up.

Slip the outside of the ring into the groove, and roll it entirely around the groove, to make sure that the ring is free and does not bind in the groove at any point, Fig. 6.

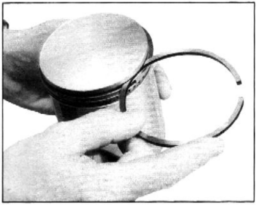

Fig. 6—Checking Ring Fit in Groove

Proper clearance of the piston ring in its groove is very important and when fitting new rings the following clearances should be adhered to:

At the top ring a .002" feeler should be very free, but a .003" feeler should cause a rather heavy drag.

At the center ring, the .002" feeler should be just free and the use of a .003" feeler should cause the ring to lock in the groove.

At the bottom, or oil control groove, the .002" feeler should produce a light drag.

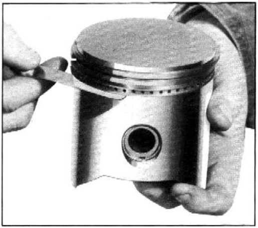

Fig. 7—Checking Piston Ring Clearance

Fig. 7 shows the method of checking ring groove clearance with a feeler gauge.

Main Bearings

Chevrolet main bearings are steel back babbitt-lined. The babbitt is centrifugally cast or "spun-in" into the steel lining. This method assures a positive bond between the steel and the babbitt and also prevents the formation of air pockets in the babbitt metal.

When it is necessary to replace main bearings, the clutch housing should not be removed from the cylinder block. This is very important, as the transmission pilot hole in the clutch housing is used in the alignment of the boring bar. Should it be necessary to replace the clutch housing, the new part must be assembled to the cylinder block and checked for alignment before main bearings are installed. The main bearing boring machine J-1000 illustrated in Fig. 8 is used for boring new main bearings in proper alignment.

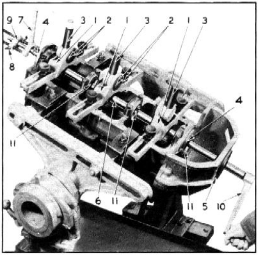

Fig. 8—Main Bearing Boring Machine

1—Support Bracket and Clamps
2—Universal Clamp Bolts
3—Boring Bar Supports and Ball Bearings
4—Boring Bar Centering Bushings
5—Clutch Housing Centering Bushing
6—Boring Bar
7—Boring Bar Feed Support Bracket
8—Feed Nut Yoke
9—Feed Screw
10—Turning Handle
11—Boring Bar Cutters

Replacing Main Bearings

The operations for replacing main bearings are as follows:

1. Support the crankcase in motor stand with bearing side of case up.
2. Remove old bearings and see that case is well cleaned.
3. Install centering bushings (4), Fig. 8, in the front and rear bearing bores and install the bearing caps without shims.
4. Thread the boring bar (6) through the bushings from the rear to the front. Then mount the dial gauge on the boring bar and check the alignment of the transmission pilot hole in the clutch housing as shown in Fig. 9. The runout must not exceed .015". If it does, it will be necessary to replace the clutch housing before proceeding with the job of installing new main bearings.
5. Remove the boring bar and the centering bushing in the rear bearing. Then install the clutch housing centering bushing (5) in the transmission pilot hole of the clutch housing.

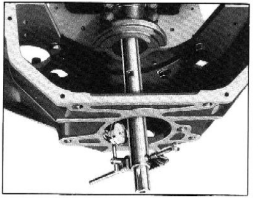

Fig. 9—Clutch Housing Alignment

6. Install the boring bar through the rear centering bushing and thread the boring bar support bearings (3) over the bar, locating one support in the space between each two bearings. Be sure to push the boring bar through the front centering bushing beyond the reduced diameter portion.
7. Install the boring bar support brackets (1) and line them up so there will be clearance between the bearing cap and support bracket for the installation and removal of cutters. Clamp the support brackets firmly to the pan rail of the cylinder block.
8. Tighten the universal clamp bolts (2) on each support bracket evenly. As the bolts are being tightened, the boring bar should be turned by hand to make sure that it is free to turn without any indication of a bind. Remove the boring bar and the front centering bushing.
9. Install the bearing shells in the cylinder block and caps.

   NOTE—The front and front intermediate bearing shells are very similar in appearance and it is possible to get them mixed. The front intermediate shells are identified by the letter "I" in the bottom of the oil groove. Should the intermediate bearing shell be installed in the front bearing bore, the sides of the bearing would be too high and would not permit the cap to seat firmly on the shims.

10. Place four .002" shims on each side of each bearing and install the caps. The intermediate bearing caps are marked "front" and "rear" for identification purposes. The front intermediate bearing cap is installed with the "FRONT" mark to the front of the engine and the rear intermediate bearing cap is installed with the "REAR" mark to the rear of the engine.

    The rear intermediate bearing shell is flanged because it takes the end thrust of the crankshaft.

    Tighten the bearing cap bolts evenly and make sure they are drawn down tight.
11. Examine the boring bar to make sure the cutter seats are clean; then install the bar through the rear centering bushings and bearing supports. Examine the cutters to make sure they are clean and install them in the slots in the cutter bar. Cutters are lettered F—FC—RC—R to designate front, front center, rear center, and rear.
12. Mount the feed screw support bracket (7) on the front boring bar support. Mount the feed screw (9) in its U-shaped yoke and install the screw in the end of the boring bar. Adjust the bar so that the cutters are just about to enter the bearings; then tighten the two feed screw support thumb screws.
13. Install the turning handle on the end of the boring bar and proceed with the boring operation. During this operation, use a liberal supply of kerosene to keep the cuttings washed out of the bearings.
14. After the cutters have passed through the bearings, remove turning handle and feed screw. Blow all cuttings out of the bearings with compressed air, being careful not to blow the cuttings into the boring bar support bearings.
15. Slide the boring bar back until the cutters have passed through the bearings; then again install the feed screw and bore through the bearing a second time. This is very important in order to obtain a perfectly smooth, true bearing.
16. Remove turning handle, feed screw, cutters and boring bar. Do not disturb the boring bar supports because they will be used when facing rear intermediate bearing for crankshaft end clearance.

Facing the Rear Intermediate Bearing

1. Install the boring bar through the centering bushing and the rear bearing support. Slip the facing cutters on the boring bar, one on each side of the rear intermediate bearing.
2. Place the feed screw sleeve in the front intermediate bearing and push the boring bar through the sleeve. Install the feed screw drive key through the hole in the sleeve and into No. 2 cutter hole in the boring bar, locking the key in place with its screw.
3. Adjust the feed screws for equal feed range on each side of the front intermediate bearing. Adjust the facing cutters to provide about .015" clearance between the cutter face and the flange of the bearing. Lock the cutters to the boring bar with the clamp screws.

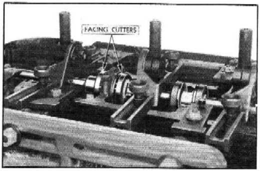

Fig. 10—Facing Rear Intermediate Bearing

4. Caliper the width of the rear intermediate bearing journal on the crankshaft with the special inside and outside calipers, KMO-964.
5. Install the turning handle on the end of the boring bar. Back off the front feed screw collar several turns and tighten the rear feed screw collar until the front facing cutter contacts the bearing flange. Then proceed with the facing operation; tightening the feed screw is necessary to keep the cutter in contact with the bearing flange.

   The front flange of the bearing should be machined just enough to thoroughly clean up the face. The proper installation of this tool is shown in Fig. 10.
6. Back off the rear feed screw collar and tighten the front collar until the rear cutter engages the bearing rear flange. Then continue with the facing operation, checking the progress of the job every few turns with the special caliper that was set for the width of the crankshaft journal. Continue facing the bearing until the special caliper will pass over the bearing and a .004" feeler laid alongside the bearing flange.

   Remove the bearing cap and place it on the rear intermediate journal of the crankshaft. Check the end clearance with a feeler gauge; the correct clearance is .004" to .007".
7. Disassemble the facing cutters and boring bar from the cylinder block. All parts of this tool should be thoroughly cleaned and oiled to prevent rusting, and put away in the special boxes provided for this purpose.

Crankshaft Rear Bearing Seal

The rear main bearing is sealed by a wick-type seal installed in a groove machined in the block and cap as shown in Fig. 11.

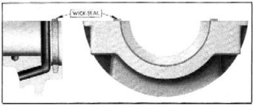

Fig. 11—Rear Main Bearing Oil Seal

To install a new wick seal at the rear main bearing cap, insert the packing in the groove with the fingers. Then using a rounded tool, roll the packing into the groove. When rolling the packing, start at one end and roll the packing to the center of the groove, Fig. 12. Then starting from the other end, again roll toward the center.

By following the above procedure you are assured that the wick is firmly pressed into the bottom of the groove.

The small portion of the wick which protrudes from the groove at each end should be cut flush with the surface of the bearing cap. To prevent the possibility of pulling the wick out of the groove while cutting off the ends, it is recommended that a round block of wood the same diameter as the crankshaft flange be used to hold the packing firmly in position while the ends are being cut off.

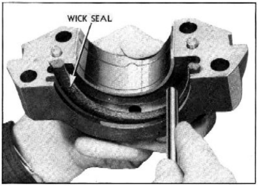

Fig. 12—Installing Rear Main Bearing Oil Seal

If it should become necessary to replace the upper half of the wick seal, it will be necessary to remove the engine from the chassis and remove the crankshaft.

The procedure for installing the wick in the cylinder block is exactly the same as for installing it in the bearing cap.

CRANKSHAFT

One of the main reasons for the smooth engine performance of Chevrolet's six-cylinder engine is its rugged crankshaft. It weighs 68 pounds, has heavy counterweights and extra large bearing diameters.

The crankshaft main bearing journal and connecting rod journal sizes are as follows:—Front, 2.6835"-2.6845"; Front Intermediate, 2.7145"-2.7155"; Rear Intermediate, 2.7455"-2.7465"; Rear, 2.7765"-2.7775"; Connecting Rod Journal, 2.311"-2.312".

Whenever a crankshaft has been removed from an engine, it is important that these dimensions be checked with a micrometer for out of round, taper and undersize. If the journals exceed .001" out of round or taper, the crankshaft should be replaced. Slightly undersize journals can be used providing that they are within the above limits for out of round or taper.

Any time the crankshaft is removed from the engine it should also be checked for runout. To perform this operation, support the crankshaft at the front and rear main bearing journals in "V" blocks and indicate the runout of both the rear intermediate and front intermediate journals, using a dial indicator. The runout limit of each of these journals is .002".

Installing Crankshaft

Blow out all cuttings from the bearings.

Clean out all oil passages by blowing them out with compressed air. It is a good practice to blow out each oil passage separately—this can be done by placing the fingers on the oil hole in three of the bearings while the nozzle of the air gun is placed in the oil inlet of the cylinder block. After blowing out the oil passages of all four bearings, then blow through each of the oil passages from the main bearings to the camshaft bearings.

Proper cleaning of all oil passages is very important and must be done thoroughly.

Lubricate all four bearings and carefully place the crankshaft in the bearings.

Check the end play by forcing the crankshaft to its extreme rear position. Check at the rear side of the rear intermediate bearing with a feeler gauge. See Fig. 13. This clearance should be from .004" to .007".

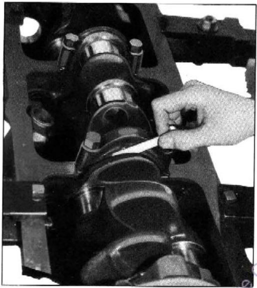

Fig. 13—Checking Crankshaft End Play

Install the bearing caps with four .002" shims on each side and pull the bolts down snugly. Check to see that the crankshaft rolls freely.

Adjusting Main Bearings

Starting with the rear bearing, remove shims evenly until there is a slight drag on the crankshaft (turning it by hand) with the bolts pulled down tight. Then replace one .002" shim for clearance, again tighten the bolts and check for drag. The crankshaft should now roll freely without any indication of a drag.

Loosen the bolts on the bearing that has just been adjusted and proceed to adjust the next one in the same manner and so on until all bearings have been adjusted.

When adjusting the bearings, shims should be removed evenly. If an uneven number of shims have to be used, it is good practice to have the greater number of shims on the same side of all bearings.

By following the procedure of removing shims to check and then replacing one .002" shim, there will be no possibility that the bearing will be too loose. Then if the crankshaft may be turned freely by hand, it is certain that the bearing is not too tight.

If the shaft turns freely by hand, after all bolts have been tightened, you know the bearings are properly adjusted.

CAMSHAFT BEARINGS

All four of the camshaft bearings are steel backed, babbitt lined bearings. They are pressed into the crankcase and staked into place to prevent rotation and endwise movement. They are accurately line reamed at the time of assembly, assuring proper alignment of the camshaft. These bearings are lubricated through holes which line up with the oil passages from the main bearings.

To remove, replace, and line ream the camshaft bearings in service, a special set of tools, J-946, is necessary. This set consists of a removing and replacing bar, four removing and replacing sleeves, a bracket which is attached to the rear of the cylinder block and a special camshaft bearing reamer, shown in Fig. 14.

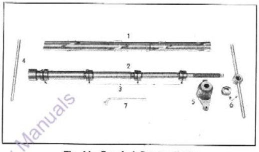

Fig. 14—Camshaft Bearing Tools

1—Reamer
2—Removing and Replacing Bar
3—Removing and Replacing Sleeves
4—Extension Handle
5—Bracket
6—Handle and Thrust Bearing
7—Staking Tool

Removal

1. Drive out the expansion plug at the rear of the rear camshaft bearing.
2. Assemble the camshaft bearing remover bracket loosely to the rear of the cylinder block.
3. Start the bearing puller bar through the front bearing and install the puller sleeve for each bearing over the bar before the bar has passed through that particular bearing. Then pass the bar through the hole in the bracket. Tighten the bolts that hold the bracket to the crankcase. Then install the thrust bearing and puller handle on the end of the bar.
4. Turning the puller handle will now remove all four bearings at one time. An extension handle is provided to aid in starting bearings that may have corroded in the case.

Replacement

1. To make sure that the oil holes in the camshaft bearing bores will line up with the oil holes in the camshaft bearings after the bearings have been installed, mark the position of the oil hole in the bore on the front face of the bearing bore.
2. Place a new front camshaft bearing over the puller bar and start the bar through the front bearing bore. Place the puller sleeve with a new bearing over the bar before passing the bar through the bearing bore in the cylinder block. Pass the end of the bar through the puller bracket and install the thrust bearing and turning handle.

3. Line up the oil holes in each bearing with the oil hole location marks previously made. All four bearings can now be pulled into place at the same time.
4. Remove the puller bar and bracket and then stake each bearing into the hole provided in the bore for that purpose.

Reaming Camshaft Bearings

The special camshaft bearing line reamer has all four cutters mounted on one bar so that all of the camshaft bearings will be in perfect alignment after the reaming operation.

1. Pass the reamer through the first, second, and third bearings. Then start the reamer cutters into all four bearings and turn the reamer slowly until the cutters have passed through the bearings. While the bearings are being reamed, a liberal supply of kerosene should be used to keep the cuttings washed out of the bearings.
2. Remove the reamer by pulling it back through the bearings, at the same time turning the reamer slowly in the same direction as when reaming the bearings.
3. Blow all cuttings from the bearings with compressed air. Install the camshaft and check all bearing clearances with a narrow feeler gauge. The proper clearance is from .002″ to .004″. Install the expansion plug in the cylinder block at the back of the rear camshaft bearing.

Camshaft

The camshaft is designed to assure quiet operation, combined with accurate valve timing. The contour of the cams is carefully worked out to take up the valve clearance gradually. The valve lifters are located slightly off the center line of the cams. This design results in spinning the lifter so the cams do not engage the same point on the lifters each time the valves open, resulting in long valve lifter life and quiet operation.

The following is a list of the sizes of the camshaft bearing journals: front, 2.0282″-2.0292″; front intermediate, 1.9657″-1.9667″; rear intermediate, 1.9032″-1.9042″; rear, 1.8407″-1.8417″.

Whenever a camshaft is removed from an engine, it is important that these dimensions be checked with a micrometer for out of round. If the journals exceed .001″ out of round, the camshaft should be replaced.

Another very important inspection operation, when the camshaft is removed from the engine, is to check it for alignment. The best method is by use of "V" blocks and a dial indicator as shown in Fig. 15. The dial indicator will indicate the exact amount that the camshaft is out of true. If it is out more than .002″ dial indicator reading, the camshaft should be straightened. When checking, the high reading of the dial indicator indicates the high point of the shaft. This point should be chalk marked so you can tell exactly where to apply pressure when straightening.

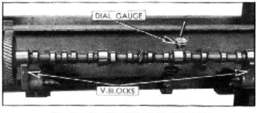

Fig. 15—Checking Camshaft Alignment

NOTE—During the straightening operation, care should be taken to protect the bearing journal to prevent damage to its surface.

After the camshaft has been straightened, it should be re-checked to be sure that it is within .002″ dial indicator reading for alignment.

CRANKCASE FRONT END PLATE

The crankcase front end plate is assembled to the cylinder block with from one to three gaskets. The removal or replacement of one or more gaskets provides an adjustment for aligning the timing gears.

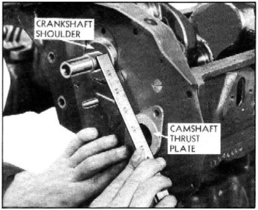

Fig. 16—Checking Alignment of Timing Gears

In assembling the crankcase front end plate to the cylinder block, first use two gaskets and hold in place with three screws. Then place a new camshaft thrust plate over the camshaft hole in the end plate. Using a scale laid against the thrust plate and over to the shoulder on the crankshaft for the timing gear, check to see whether or not these two surfaces are flush, Fig. 16. If the scale strikes the shoulder on the crankshaft, add another gasket. If there is space between the scale and the shoulder on the crankshaft, remove one gasket.

After the proper number of gaskets have been installed between the plate and the crankcase, assemble the screws and bolts, setting the screws with a center punch.

Crankshaft and Camshaft Gears (Timing Gears)

The gear on the end of the crankshaft, or the crankshaft timing gear, is cut from a solid piece of steel. It is a drive fit on the end of the crankshaft as well as being held in place with a key.

To remove this gear, without damage to it, a gear puller T-126-R, such as is shown in Fig. 17, is necessary. To replace this gear, a driver is essential so that the gear can be driven straight back on its seat accurately.

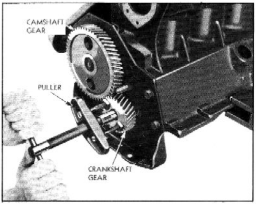

Fig. 17—Crankshaft Gear Puller

The camshaft gear, or camshaft timing gear, is a composition gear which has been pressed into gear blanks under enormous pressure. After this blank has been made, the teeth and the inside hole of the gear is machined, the timing mark punched on it and the keyway cut. This gear together with the steel crankshaft gear gives long, quiet, trouble free life.

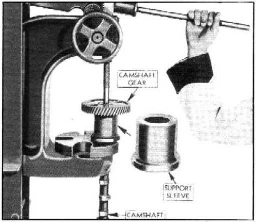

Fig. 18—Camshaft Gear Removing Sleeve

If it becomes necessary to replace the camshaft gear, a sleeve J-971 to properly support the gear on its hub is necessary. This sleeve, shown in Fig. 18, removes the gear, but it so damages the thrust plate that it is very important that every time a gear is removed from the camshaft, a new thrust plate must be used.

In replacing the gear on the camshaft, the back of the front journal of the camshaft must be firmly supported in an arbor press and the camshaft thrust plate assembled to the camshaft, after which the gear is pressed on the shaft far enough so that the camshaft thrust plate has practically no clearance, yet is free to revolve. The correct clearance is—a free fit to a maximum of .003″. It is very important that the gear be pressed on the camshaft using the hub of the gear as a pressing medium and not the

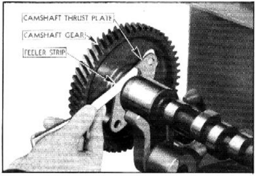

Fig. 19—Checking Camshaft End Play

outside of the gear. Serious damage will be done to the gear if it is pressed on the shaft using the outside of the gear.

The thrust bearing, on the inside of the camshaft gear, when it is assembled to the camshaft, determines the amount of camshaft end play.

If there is an excessive amount of end play in the camshaft, it is necessary to remove the gear and shaft assembly and press the gear further on the shaft so that the thrust plate is tight, yet free to revolve, to a maximum of .003″ clearance. See Fig. 19.

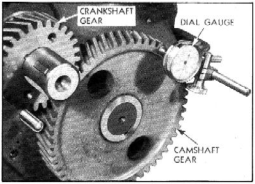

Fig. 20—Checking Run-Out of Camshaft Gear

When the camshaft and gear are assembled to the engine, it is important that the punch marks on both the camshaft and the crankshaft gear be opposite each other.

The camshaft will then be in its proper position so that the valves will open and close in the proper relation to the movement of the piston.

After the camshaft and crankshaft gears are in their proper places, check the crankshaft timing gear for run-out with a dial indicator. This should not exceed .003″. Then check the run-out of the camshaft gear. This should not exceed .004″. Fig. 20.

If these run-outs are excessive, remove gears to be sure that burrs on the shaft or gears are not causing run-out. If necessary replace with new gears. The back lash should be checked. This check

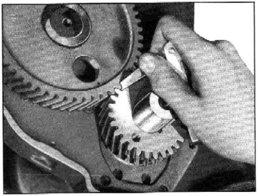

Fig. 21—Checking Timing Gear Backlash

is made with a feeler gauge placed between the teeth of the gears. This should be from .002" to .005". Fig. 21.

Valve Timing

The valve timing is illustrated in Fig. 22. The reader will note that the inlet valve starts to open 3 degrees before upper dead center and continues open for 218 degrees, closing 35 degrees past lower dead center.

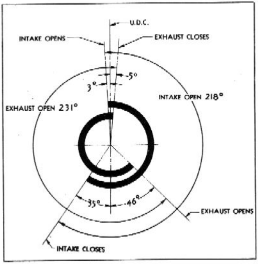

Fig. 22—Valve Timing

The exhaust valve starts to open 46 degrees before lower dead center and continues open for 231 degrees, closing 5 degrees past upper dead center.

To check the valve timing use Number 1 cylinder exhaust valve.

1. Tighten the adjusting screw to just remove all tappet clearance.
2. Hand crank the engine until the Number 1 cylinder exhaust valve starts to close. Continue cranking the engine until the triangular mark on the flywheel lines up with the pointer in the flywheel housing.
3. Mount a dial gauge on the rocker arm shaft support with the spindle of the indicator on top of Number 1 cylinder exhaust valve adjusting screw. Set the indicator at .036".
4. Continue to hand crank the engine until the indicator hand just stops moving. At this point the indicator should read zero, plus or minus .003".

Fig. 23 illustrates checking the valve timing.

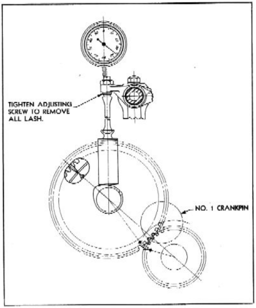

Fig. 23—Checking Valve Timing

Timing Gear Lubrication

In order to properly lubricate the timing gears, a timing gear oil nozzle is pressed into the crankcase front end plate and the end spun over.

In the event the oil nozzle is damaged, it will be necessary to replace the front end plate as it is impractical to replace the nozzle with equipment available in the field.

TIMING GEAR COVER

The timing gear cover is a pressed steel stamping, heavily ribbed for strength. A spring loaded leather seal is assembled into the crankshaft opening to prevent oil leakage around the hub of the fan pulley. The seal is pressed into a pocket in the cover by the use of Oil Seal Replacer J-995.

When it becomes necessary to replace the leather seal, the special tool, J-995, illustrated in Fig. 24, should be used. Place a new oil seal on the driver with the free end of the leather toward the end of the tool. The seal can then be driven into place in the cover with a few light blows of a hammer.

When installing a timing gear cover, it is essential that it be centered. The guide J-966, illustrated in Fig. 25, fits over the crankshaft and, when in position, guides and holds the timing gear cover in

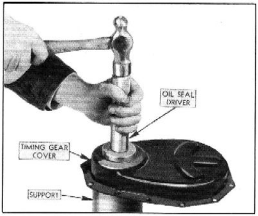

Fig. 24—Installing Timing Gear Cover Oil Seal

its correct position, so when the Harmonic Balancer is installed it will not damage the oil seal. A coating of grease, around the inside surface of the leather, will aid in preventing damage to the seal during this operation.

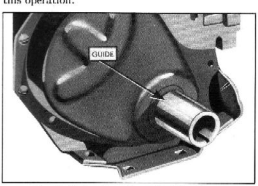

Fig. 25—Timing Gear Cover Centering Gauge

HARMONIC BALANCER

The Harmonic Balancer consists of a small flyweight attached to and driven by the crankshaft through two rubber annular rings mounted over six studs which are riveted to the hub.

When the engine is running, any change in the speed of the crankshaft, which would cause vibration, will be resisted by the action of the balancer. This resistance is produced by a floating action between the rubber annular rings and the six driving studs. The flyweight moves back and forth on the rubber mounted studs in the opposite direction to that of the crankshaft, and thereby dampens out or absorbs crankshaft vibrations.

Due to the construction of the balancer the parts are not serviced separately. The Harmonic Balancer is not interchangeable with previous models due to a difference in length.

The puller J-1287 (Fig. 26) is made in three parts, a drop forged puller body, a puller screw and a driver head. The driver head is made of tool steel with a drill rod pin which is replaceable.

In operation the puller body is attached to the balancer by means of the two cap screws in the

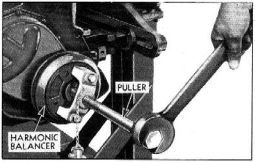

Fig. 26—Harmonic Balancer Puller and Driver

puller, which screw into the tapped holes in the balancer. This insures the puller body being held firmly against the balancer and helps to hold the balancer together while it is being removed. Next turn the puller screw into the body until the balancer is removed. This puller provides a steady pull on the balancer allowing its removal without damage.

In installing this part the puller body is removed and the driver placed in the starting crank jaws and the puller body reassembled to the balancer. Next line up the key in the crankshaft and the keyway in the balancer and drive the balancer in position using the puller screw as a driver. If the puller is assembled in any other than this way serious damage will be done to the balancer.

Flywheel

The flywheel is made from a grey iron casting which is accurately machined and balanced to assure smooth engine performance. A steel ring gear is shrunk on its outer diameter, that meshes with the starter gear when starting.

The flywheel is located on the crankshaft flange

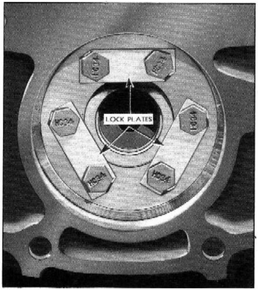

Fig. 27—Flywheel Bolt Locks

by three dowels and is retained by six special large head cap screws. These bolts are locked by lock plates as shown in Fig. 27.

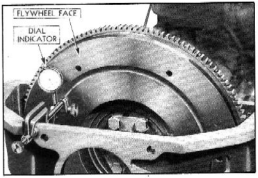

Fig. 28—Checking Flywheel Run-Out

After the flywheel has been assembled to the crankshaft, it is necessary that the face and the rim of the flywheel be checked for run-out.

This can be done with the dial indicator as shown in Fig. 28. The face and rim of the flywheel should not exceed .008" run-out.

Connecting Rods

The connecting rods are made of special steel, drop-forged and of unusual strength. The babbitt bearings are centrifugally cast or "spun-in" into the forging. This method assures a positive bond between the steel and babbitt which aids in dissipating heat from the bearings.

Every time a connecting rod is removed from an engine or a new connecting rod is being installed it should be checked for alignment on a connecting rod alignment fixture as shown in Fig. 29.

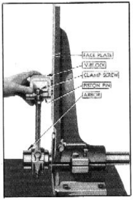

Fig. 29—Connecting Rod Alignment Fixture

Connecting Rod Alignment

To check a connecting rod for alignment, proceed as follows:

1. Place the piston pin in the eye of the rod and tighten the clamp screw.
2. Place the connecting rod on the aligner arbor and tighten the connecting rod bolts.
3. Place the "V" block on the piston pin, then move the rod and arbor toward the face plate until the pins on the "V" block just engage the face plate. If all four pins touch the face plate the rod is in perfect alignment. However, should the top pins rest against the face plate and the bottom pins are away from it, the rod is cocked or bent. The same is true if the bottom pins rest against the face plate and the top pins are away from it.

If the two pins on the front side of the "V" block rest against the face plate and the two back pins are away from it, the rod is twisted. The same is true if the back pins engage the face plate and the front pins are away from it.

The fixture is sufficiently strong to hold the connecting rod, if straightening is necessary, which may be done with a bending bar.

Assembling Connecting Rod to Piston

Place the piston in a piston vise as shown in Fig. 30. Assemble the rod to the piston and install the pin. Before tightening the clamp screw, center the piston pin in the piston and the rod in the center of the two piston pin bosses. Tighten the clamp screw and move piston on the pin from side to side, checking to see that the piston pin does not extend outside of the piston.

NOTE—The connecting rod should never be clamped in a bench vise when installing the piston to it, as tightening the clamp screw will likely twist the rod.

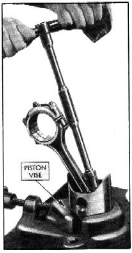

Fig. 30—Assembling Connecting Rod to Piston

Assemble the piston and connecting rod assembly to the alignment fixture, shown in Fig. 31, and check with the "V" block resting against the piston skirt to see that the rod and piston are in alignment. Both pins on the "V" block should rest against the face of the plate on the fixture. The piston should be in the same alignment as the connecting rod when this check is made.

A quick check of a piston and connecting rod assembly for both cock or twist can be made without disassembling the rod from the piston. This method saves considerable time on any repair operation that does not normally require the removal of the rod from the piston. To make this check, the connecting rod and piston assembly is mounted on the alignment fixture and the piston is set in line with the connecting rod. Then place the "V" block on the piston skirt, and if both pins on the block contact the face plate, the rod is not cocked. See Fig. 31. Then, with the "V" block on the piston skirt and the pins against the face plate, tip the piston first in one direction and then in the other, Fig. 32. If the pins on the block follow the face plate, there is no twist in the connecting rod. But if one pin leaves the face

Fig. 31—Checking Piston and Connecting Rod Assembly

plate while the piston is being tipped in one direction and the other pin leaves the face plate while the piston is in the other direction, the connecting rod is twisted and should be straightened until both pins follow the face plate.

Assembling Piston and Connecting Rod to Engine

In production, both the rod and the cap are stamped with the number of the cylinder in which they are to be assembled. The numbers are stamped on the camshaft side. When the rods are being reassembled they should be placed back in the same cylinder from which they were removed and the stamped numbers should be placed on the camshaft side.

The gaps in the three rings should not be in a vertical line, neither should there be any ring gap over the piston pin, as the gases could leak by

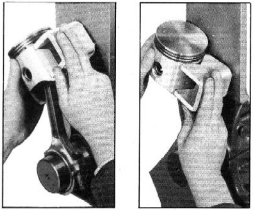

Fig. 32—Checking for Twisted Connecting Rod

more easily at this point. Therefore, it is desirable to stagger the gaps so that they will be equally spaced around the circumference of the piston.

Lubricate either the piston or the cylinder bore and start the piston and connecting rod assembly into the cylinder. Compress the rings with a ring compressor, then push the piston into the cylinder.

Lubricate the bearing, pull the connecting rod down on the crank pin making sure the marks on the rod are toward the camshaft. Install three .002″ shims on each connecting rod bolt and then install the cap with the marks toward the camshaft. Install the connecting rod dipper with the mouth of the dipper towards the camshaft. Assemble and tighten the nuts.

Adjusting Connecting Rod Bearings

Remove shims, an equal number from each side of the bearing, until the rod cannot be snapped back and forth on the crank pin by hand, but can be tapped back and forth with a light blow of an 8 ounce hammer. Then replace one .002″ shim, being careful to keep the number of shims on each side equal, if possible. When the bearing is properly fitted, it should be possible to snap the rod back and forth on the crank pin with one hand, Fig. 33.

If it is not possible to keep the number of shims on each side equal for all bearings, it is preferable

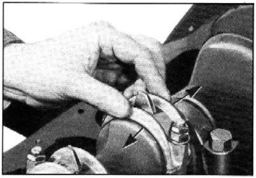

Fig. 33—Checking Connecting Rod Bearing Fit

to have the greater number of shims on the camshaft side.

Check connecting rod end clearance between the upper half of the connecting rod (not the connecting rod cap) and the side of the crank pin with a feeler gauge. This clearance should be from .004″ to .011″. See Fig. 34.

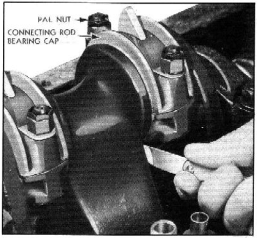

Fig. 34—Checking Connecting Rod Bearing Side Clearance

Lock the connecting rod bolt nuts by installing new "pal" nuts. The "pal" nuts must be installed with the open side of the nut toward the end of the bolt. Turn the "pal" nut up finger tight and then ½ turn more.

As a final and last check to be sure that the assembly will travel true with the bore, check the clearance between the piston pin end of the connecting rod and the piston pin bosses on the piston with a feeler gauge. This should not be less than .025″.

ENGINE OILING SYSTEM

Lubrication for the engine is supplied by a positively driven gear pump that is equipped with a spring loaded by-pass valve which controls the maximum pressure at high speeds and when the engine oil is apt to be heavy and sluggish during cold weather starting.

The engine oiling system provides positive pressure lubrication to the main bearings and camshaft bearings. The connecting rod bearings are lubricated by means of dippers on the rods which dip into troughs in the oil pan at low speeds and by oil nozzles at higher speeds. Cylinder walls and piston pins are lubricated by the oil spray. Oil for the valve mechanism is pumped up to the hollow rocker arm shafts.

MAIN AND CAMSHAFT BEARING LUBRICATION

The oil flow is from the pan, through the pump screen and oil pump to the block fitting pipe, and then to the oil manifold, thence through drilled passages in the bearing support webs in the cylinder block, to the four main bearings. The oil then passes through grooves in the bearings to the drilled passages in the cylinder block webs and to the camshaft bearings. In this manner full pressure feed lubrication is supplied to all main and camshaft bearings.

TIMING GEAR LUBRICATION

Lubrication for the timing gears is supplied by conducting the oil from the front camshaft bearing, through a milled slot in the back of the engine front end plate, to a nozzle which is so aimed that the oil stream effectively lubricates the timing gears.

CONNECTING ROD BEARING LUBRICATION

Oil for the connecting rods passes from the cylinder block fitting to the oil manifold, through a drilled passage in the cylinder block and to the oil distributor. As the oil pressure builds up, the oil distributor valve opens and releases the oil into a drilled passage in the block, this passage connecting with the short pipe that fits into the main supply pipe in the oil pan. From the main supply pipe the oil passes to the oil manifold in the oil pan, where it is distributed to the six oil nozzle pipes.

The six oil troughs in the oil pan are adjusted to the proper height so that the connecting rod dippers will dip into the oil and supply lubrication for the lower speeds.

As the engine speed is increased and the oil pressure is built up, the oil streams from the nozzles rise, and are intercepted by the dippers, forcing the oil into the connecting rod bearings under high pressure, Fig. 35. The cylinder walls, pistons, and piston pins are lubricated by the oil spray thrown off by the connecting rods.

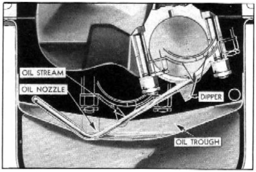

Fig. 35—Connecting Rod Bearing Lubrication

VALVE MECHANISM LUBRICATION

Oil for lubrication of the valve mechanism is tapped off at the oil manifold and is carried by a pipe which passes through the water jacket to a fitting between the two hollow rocker arm shafts where it is distributed to all rocker arm bearings. A bleeder hole in each rocker arm supplies oil for lubrication of the valve stems and push rod sockets.

Proper functioning of the oiling system is dependent upon the proper adjustment of connecting rod dippers, oil troughs, and oil nozzles.

IT IS VERY IMPORTANT THAT THESE ADJUSTMENTS BE CHECKED AND ADJUSTED EVERY TIME AN OIL PAN IS REMOVED.

CONNECTING ROD DIPPERS

The height of the connecting rod dippers is very important to insure proper lubrication of connecting rod bearings.

The oil trough depth and connecting rod dipper height gauge, J-969-2, is used to check the height of the dipper from the machined surface of the crankcase. With the two side pins of the gauge resting on the crankcase flange, Fig. 36, the end of the dipper should just touch the bottom of the cross bar on the gauge.

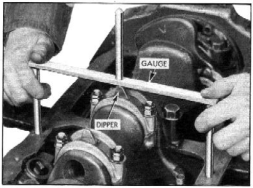

Fig. 36—Checking Connecting Rod Dipper Height

If the dipper is lower than the gauge, a new dipper must be installed.

If the dipper is higher than the gauge, it may be bent down to the correct position.

NOTE—The oil pan gasket must be removed during this operation.

Oil Pan Removal

To remove the oil pan when the engine is mounted in the chassis, raise the front end with a jack until the wheels are free, then turn the wheels to the extreme left. This is necessary to gain clearance at the tie rod.

CHECKING THE OIL PAN

To check the oil pan, proceed as follows:

1. Check the oil trough height with the oil trough depth gauge, J-969-2, by placing the bar of the gauge on the pan rail. The stem of the gauge should just touch the edge of each of the six oil troughs, Fig. 37.

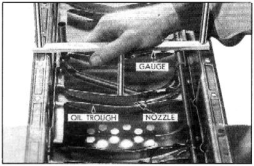

Fig. 37—Checking Oil Trough Depth

2. To check the aiming of the oil nozzles, install the oil pan target gauge, J-969-1, on the oil pan by locating the dowels of the gauge in the screw holes in the oil pan. Insert the water nozzle, J-793-3, in the main oil pipe. Tip the oil pan

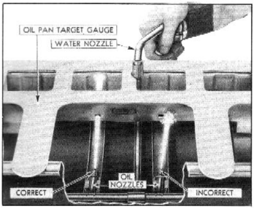

Fig. 38—Checking Aim of Oil Nozzle

about 45 degrees to prevent the water from covering the ends of the nozzles. Open the water nozzle just enough to straighten the water streams. If the oil nozzles are properly adjusted, the water streams will pass through the centers of the target holes. Both the correct and incorrect aiming of the water nozzles is shown in Fig. 38.

The oil nozzles may be adjusted by using the oil nozzle wrench, J-793-2, as shown in Fig. 39. Continue adjusting and checking the oil nozzles until each water stream passes through the center of its target hole.

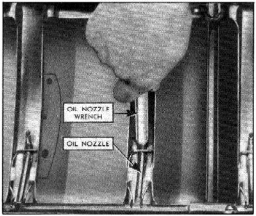

Fig. 39—Adjusting Oil Nozzle Aim

OIL DISTRIBUTOR

The Oil Distributor Valve Assembly is mounted in the side of the cylinder block. When assembling the oil distributor valve assembly, a cork gasket must be installed between the valve assembly and the block, and then another cork gasket between the valve assembly and the oil distributor cover. Fig. 40 shows the oil distributor assembly.

NOTE—Care must be used not to get these gaskets mixed. The gasket indicated by the number "1" in Fig. 40 must be assembled between the valve and the block, and gasket numbered "2" between the valve and cover.

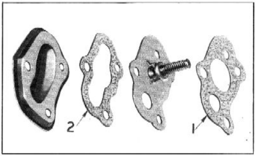

Fig. 40—Oil Distributor Parts

OIL PUMP ASSEMBLY

The oil pump is a positive gear type. It consists of two spur gears enclosed in a one-piece housing, and is provided with a relief valve to control maximum oil pressure. In operation, oil is drawn from the crankcase through a fine mesh screen which is mounted on the rear intermediate bearing. The oil then passes through a pipe to the oil pump, from which it passes to the oil distribution system as previously described.

To disassemble the oil pump, remove the cover screws and cover. Then remove the drive gear and shaft and the idler gear. Fig. 41 shows a layout of the oil pump parts.

Fig. 41—Oil Pump Parts

1—Oil Pump Body
2—Drive Gear and Shaft
3—Idler Gear
4—Cover Gasket
5—Cover

The fit of the shaft should be checked in the pump housing. Also check the spur gears for wear. If the pump parts are badly worn it is good policy to replace the entire oil pump assembly.

When reassembling an oil pump, make sure that the ground side of the idler gear is toward the cover. It is also important that only a Genuine Chevrolet Gasket be used as this gasket controls the clearance in the pump.

When securing the oil pump assembly to the cylinder block, be sure that the tapered oil pump set screw is fully seated in the tapered hole located in the neck of the oil pump housing, then lock the set screw with the lock nut.

CRANKCASE VENTILATOR BAFFLE

The purpose of this baffle is to separate the oil mist from the fumes and thereby prevent oil from being carried out of the crankcase with the fumes.

This baffle plate is held in place by two bolts; when installing always make sure the nuts are securely locked and check to make sure the connecting rods have sufficient clearance.

OIL DISTRIBUTOR TO ROCKER ARM PIPE

The pipe leading from the oil distributor to the rocker arm shaft passes directly through the water jacket of the cylinder block. This construction serves to stabilize the oil temperature.

If the oil distributor to valve rocker oil pipe is removed for any reason, it must be discarded and a new nipple and pipe assembly installed according to the following instructions:

Coat the threads of the nipple with white lead, thread the pipe through the block and screw the nipple securely into the block. Install nipple and sleeve nut at the lower end of pipe on left side of block, coating threads of nipple with white lead and tighten securely. Make bend in lower end of pipe and connect to fitting at oil distributor location. Bend pipe on right side of block so as to clear the push rod cover. Then bend the upper portion of pipe to pass through the hole in the cylinder head. Connect the pipe to the valve rocker shaft coupling. Fill the cooling system with water, start the engine and check all connections for both oil and water leaks.

Oil Filter

The oiling system of this truck is equipped with an oil filter as a further means of keeping the oil being pumped to the bearing surfaces of the engine from becoming contaminated.

The inlet pipe to the top of the filter is connected to the oil pressure gauge fitting. This fitting taps the oil manifold which extends the full length of the cylinder block. The return line from the bottom of the filter is connected with the drilled passage from the oil distributor valve. This passage connects with the oil manifold in the oil pan which feeds the oil nozzles for the connecting rods.

The drain plug on the bottom of the filter should be removed periodically to drain off any water or dirt trapped in the filter.

The filter element should be replaced every 8,000 to 10,000 miles, or when oil gauge rod shows oil is dark.

To replace the element, remove the top cover and remove the element. Remove the drain plug and drain the filter case. Wipe out inside of filter with a clean cloth. Install a new filter element and replace the cover and drain plug.

When the engine oil is changed at the same time the filter element is replaced, it is necessary to use 6½ quarts of oil for crankcase refill in order to have the oil up to the "full" mark on the oil level gauge after the filter has become filled and the element saturated.

CYLINDER HEAD ASSEMBLY

One of the most important units of any overhead valve engine is the cylinder head. It contains not only the combustion chambers and spark plugs, but the valves, inlet ports, exhaust ports and the necessary water passages to maintain the proper temperature of these important parts.

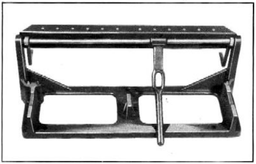

Fig. 42—Cylinder Head Holding Fixture

Grinding Valves

There is no operation, in the maintenance of an automobile, that is more important than the valve grinding operation from the standpoint of engine economy and performance.

Extreme care should, therefore, be used whenever valves are ground to maintain factory limits and clearances, as only by maintaining these limits and clearances can one expect to get good engine economy and performance.

Cylinder Head Holding Fixture

The valve heads are located in pockets in the cylinder head, and this construction necessitates the use of a cylinder head holding fixture J-982-A combined with a valve spring compressor, see Fig. 42, for the removal of valve springs and the grinding of valves.

After the cylinder head has been removed from the engine, and all of the parts disassembled from it, all carbon should be thoroughly cleaned from the combustion chambers, valve ports and guides, and the head thoroughly washed.

Valve Guides

The clearance between the valve guides and the valve stems is very important. Lack of power and noisy valves, in many instances, can be traced to worn valve guides.

The intake valve guides should be checked with a new intake valve and the exhaust valve guides should be checked with a new exhaust valve, because the diameters of the stems are different.

The exhaust valve guide is designed to bring the inner end of the guide flush with the inside of the valve port. With this design the heat dissipating properties are increased and aids in eliminating valve sticking.

The clearances that must be maintained between the intake valve stem and their guides is .001" to .003" and the clearance between the exhaust valve stems and their guides is .002" to .004".

Quite naturally, if the valve guides are worn, they should be replaced. To remove them from the cylinder head, the driver J-267 shown in Fig. 43 must be used. The cylinder head is placed in an arbor press and the guide pressed from it, using this tool.

The valve guides do not have a shoulder to determine the distance they should be pressed into the cylinder head. The intake guides should extend above the cylinder head 1-1/16" while the exhaust guide extends above the head 61/64". These dimensions are very important. See Fig. 44.

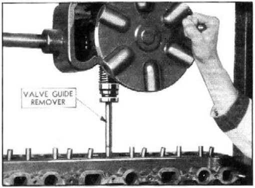

Fig. 43—Valve Guide Remover

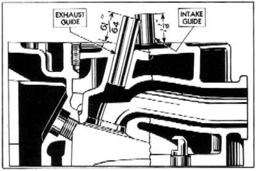

Fig. 44—Valve Guide Height

To simplify this operation and make sure the valve guides are pressed in the proper distance, two valve guide drivers are available. These drivers have stop collars on the driver body to automatically stop the guides at the proper height.

After the guides have been pressed into the cylinder head, they should be rough reamed with a .341" reamer and then finish reamed with a .343" reamer.

Reseating Valve Seats in Cylinder Head

Reconditioning of the valve seats on modern high compression engines is becoming more and more important, because the seating of the valves must be perfect in order for the engine to deliver the power and performance that has been built into it.

Another important factor is the cooling of the valve heads. Good contact between the valve and its seat is imperative if the heat in the valve head is to be properly dissipated.

There are a number of valve seat grinders and various valve reseating equipment on the market. When using them, the instructions of the manufacturer should be followed.

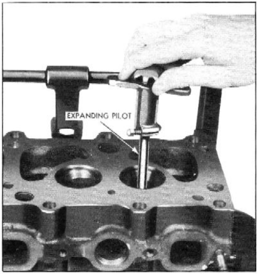

Fig. 45—Installing Expanding Pilot

We recommend a grinder of the eccentric type for the reconditioning of valve seats, the use of which will be described in the following paragraphs.

Before attempting to grind any seat, clean carbon thoroughly from the valve port, wipe seat with gasoline, cleaning it of any grease or foreign matter. Great care should be taken to clean the inside of the guide with a wire brush and make sure it is free from carbon and dirt. These precautions permit proper centering of the pilot in the guide.

Install the expanding pilot in the guide, using the special handling wrench; expand the pilot with the knurled knob on the top of the wrench, Fig. 45, and remove the handling wrench.

Dressing the Grinding Wheel

The grinding wheel should be dressed before commencing any valve regrind job. Set the grinder over the two top pilots of the dresser stand. When the grinder is seated on these pilots, the wheel will pass over the stud projecting through "A" and the grinder will be in position ready to dress the wheel, Fig. 46. Set the diamond dressing tool at the 30 degree angle. Turn on the switch and dress the grinding wheel.

NOTE—Never let the grinding wheel become glazed or loaded, as it will not grind freely and do accurate work.

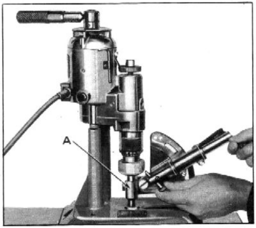

Fig. 46—Dressing Grinding Wheel

Place the grinder over the expanding pilot, then loosen the Allen set screw "B," and push down the adjusting rod "C" against the top of the pilot, Fig. 47. Then lock the set screw "B" tightly.

Turn the feed screw "E" to the right until the grinding wheel just clears the seat. Balance the grinder with the compensating handle "F," Fig. 48. Start the motor and feed the grinding wheel into the seat by turning the feed screw "E" to the left one notch at a time until the wheel is grinding all around the face of the valve seat. Before shutting off the grinder, stop feeding the wheel into the seat and give it time to grind itself free. Turn off the switch and allow the grinder to come to a stop before lifting it from the pilot.

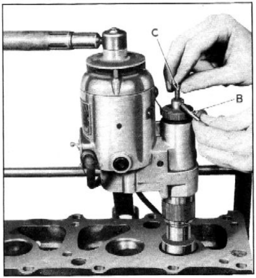

Fig. 47—Setting Adjusting Rod

Mount the valve seat dial indicator on the stationary pilot, set the indicator at zero and turn the sleeve of the indicator with thumb and finger. When the seat is properly ground, the indicator reading will be within .001", Fig. 49.

The valve seat may now be narrowed down to the proper width by machining both the port and the top of the valve seat. A 70 degree grinding wheel may be used in the port, but a form cutter, KMO-105-7, must be used to thin down the intake valve seat from the top, Fig. 50, and at the same time

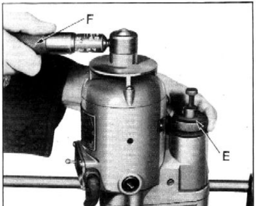

Fig. 48—Grinding Valve Seat

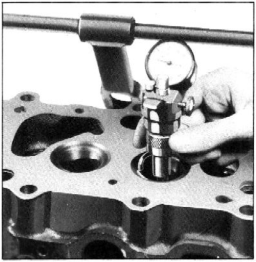

Fig. 49—Checking Valve Seat with Indicator Gauge

machine the edge of the valve recess, thereby preventing restriction of free flow of the incoming gases. The exhaust valve seat may be thinned down from the top with a 20 degree grinding wheel.

Good judgment must be used when narrowing a valve seat to make sure the seat contacts the center of the valve. The width of the intake valve seat should be from $\frac{3}{64}''$ to $\frac{1}{16}''$ and the exhaust valve seat from $\frac{1}{16}''$ to $\frac{3}{32}''$. This is very important because the life of a valve grind job depends to a great extent upon the width of the valve and seat contact.

If the valve seat is too narrow, heat cannot be dissipated from the valve head fast enough. If the valve seat is too wide, carbon particles can be readily caught between the valve and seat causing blow-by, that will soon burn both the valve and the seat.

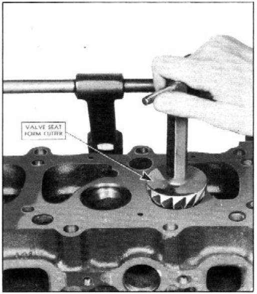

Fig. 50—Narrowing Valve Seat

Valves

Chevrolet valves have a high resistance to heat, corrosion and pitting. They are made from silichrome stainless steel by what is known as an extruding process.

From the rough forging to the finished product all operations are carefully performed and inspections are frequent.

When valves are removed, the valve stems and heads should be cleaned on a buffing wheel to remove all carbon and other foreign matter.

The condition of the valves and valve stems can now be checked.

Refacing Valves

Valves that are pitted can be refaced to the proper angle, insuring correct relation between the head and stem, on a valve refacing machine. The grinding wheel on the valve refacing machine should be properly dressed to make sure it is true and smooth. The chuck must be set at the proper angle which is 30 degrees.

The instructions of the manufacturer of the valve refacer being used should be carefully followed.

To test for perfect contact, mark lines with a lead pencil about $\frac{1}{4}''$ apart on the beveled edge of the valve head and replace the valve.

Give the valve one-half turn to the right and one-half turn to the left, using a little extra pressure on the valve. If all pencil marks are removed, the grinding is perfect. If, on the other hand, one line or part of one remains untouched, this fact indicates an uneven spot, and the valve must be reground until it seats properly.

Before replacing the valves in the cylinder head, clean the valves and the cylinder head. A good valve job is frequently ruined by failure to properly clean all of the parts.

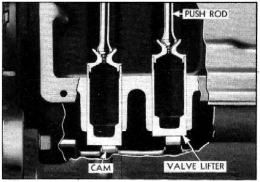

Fig. 51—Cross-Section of Valve Lifters

Valve Lifters and Push Rods

Chevrolet Valve Lifters are made in two parts. The lower part of the lifter is machined from a casting, the bottom of which is chilled during the casting operation to produce a hard wearing surface. The upper part of the lifter which incorporates the push rod seat is machined and hardened to pro-

duce a smooth, long-wearing seat. The lifter unit is completed by brazing the steel seat into the cast part of the lifter. Fig. 51 shows the construction of the lifter in cross-section.

The Push Rods are made from a solid piece of steel with the two ends forged to form the contacts with the lifter and rocker arm adjusting screw. These ends are carefully machined and hardened to produce a smooth hard surface that will give thousands of miles of service with the minimum amount of wear.

When assembling the valve lifter to the engine, it should be a free fit, and the end that contacts the camshaft should be smooth. If the end shows signs of wear or roughness, it is good practice to replace it.

Valve Springs, Caps and Covers

Valve springs are made from a special analysis steel wire. They are accurately coiled and, after being made, each spring is checked to be sure that it comes within the limits for tension. Any springs that fail to pass this inspection are immediately scrapped.

Weak valve springs affect the economy and power of the engine; therefore, each time the valves of an engine are ground, the valve springs should be checked to be sure they have not been weakened from the heat of the engine. This can easily be done

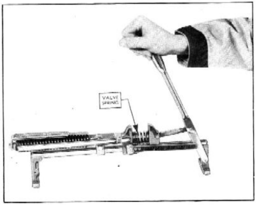

Fig. 52—Valve Spring Tension Gauge

by placing the valve spring in the Valve Spring Tester U15 (Fig. 52) and compressing it to a length of 1½". At this length the spring tension should be from 125 to 133 pounds. Any springs that do not test within these limits should be replaced with new ones.

The valve spring is retained to the valve with a cap and a key. It is necessary to compress the spring with the spring compressor shown in Fig. 53, which is a part of the cylinder head holding fixture, far enough to allow the key to be inserted in the valve stem.

The valve springs are assembled with the close coiled end toward the cylinder head.

NOTE—The round valve caps must be installed on the intake valves and the hexagonal caps on the exhaust valves.

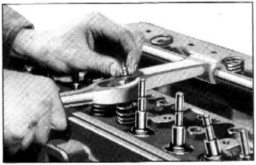

Fig. 53—Valve Spring Compressor

Valve spring cap covers are installed on the valve stems. This is an umbrella type of cover designed to carry the oil which has flowed down the rocker arm to lubricate the valve end of the rocker arm out over the valve spring, thereby reducing the amount of oil which reaches the valve stem for guide lubrication to only that required to properly lubricate the valve stem.

Installing Cylinder Head Assembly

It is good practice to install a new cylinder head gasket each time the cylinder head is removed.

CAUTION—The cylinder head gasket must be installed with the side marked "This side up" on top, Fig. 54.

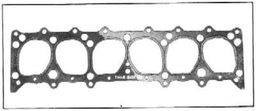

Fig. 54—Cylinder Head Gasket

To properly align the cylinder head to the cylinder block and keep the cylinder head gasket in place and free from damage while replacing the cylinder head, guide pins N-344 should be used. They screw into the cylinder block at the front and rear holes on the manifold side and guide the head into position.

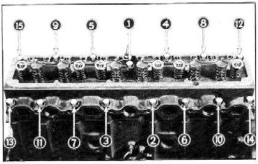

Fig. 55—Cylinder Head Bolt Tightening Sequence

After the head has been properly aligned, insert and tighten the cylinder head bolts with a wrench, tightening each one evenly a little at a time in the order shown in the cylinder head bolt tightening diagram, Fig. 55. The order in which the bolts are tightened is important, as many water leaks between the cylinders are caused by improper tightening of cylinder head bolts.

When torque wrenches are used to tighten cylinder head bolts to secure uniform tension on all bolts, the recommended tension is from 75 to 80 foot pounds.

Rocker Arms and Shafts

The rocker arms are made of Armasteel, the ends which contact the valves are hardened, the bearings for the rocker arm shaft are diamond bored. After boring, the rocker arms are "granodized" for protection against scuffing or scoring during the break-in period.

Four different rocker arms are used—right- and left-hand intake and right- and left-hand exhaust.

Each type arm carries a different part number and for identification purposes a number is cast on the side of each arm, Fig. 56.

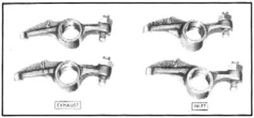

Fig. 56—Rocker Arm Identification

Number on Rocker Arm	Type Rocker Arm	For Cylinder	Part No.
1	L.H. Exhaust	1-3-5 Exhaust	839459
2	R.H. Exhaust	2-4-6 Exhaust	839460
5	L.H. Intake	2-4-6 Intake	839463
6	R.H. Intake	1-3-5 Intake	839464

The proper order in which the rocker arms should be assembled according to the numbers on the arms is shown in Fig. 57. Care should be taken when replacing rocker arms to insure having each arm in the proper location for the valve and cylinder.

The rocker arm shafts are hollow and have holes drilled in them to allow oil to pass into the rocker arm bearings. Worn rocker arm shafts should be replaced.

The rocker arms, springs and shaft supports are assembled to the rocker arm shafts and locked in place with hair pin springs.

One end of each shaft is plugged and they must be installed to the cylinder head with the open ends toward the center. A stamped steel baffle is pressed into the open end of the rear rocker arm shaft. This baffle must be installed in the vertical plane. The rocker arm shafts are connected for oil feed at the center by the brass oil connector which slips over the end of each shaft. Therefore, when removing or replacing the rocker assemblies, they must be handled as one unit.

VALVE ADJUSTMENT PROCEDURE

Before adjusting Valve Clearance, the engine must be thoroughly warmed up to normalize the expansion of all parts and stabilize the oil temperature. This is very important because during the warm-up period, the valve clearance varies considerably.

Tests have shown that during the warm-up period, when starting with a cold engine and running idle, the following variations in valve clearance take place until the engine is normalized. These tests were made with the valve clearance adjusted at a base setting of—Intake .006" and Exhaust .013".

Time Minutes	Valve Clearance Intake	Valve Change Exhaust	Oil Temperature Degrees F.	Water Temperature Degrees F.
0	.006"	.013"	70°	70°
3	.009"	.010"	95°	125°
5	.011"	.012"	115°	155°
10	.010"	.012"	160°	185°
15	.0075"	.0095"	180°	185°
20	.0065"	.008"	190°	185°
25	.006"	.012"	185°	185°
30	.006"	.013"	185°	185°

Covering the radiator with a blanket will not materially hasten the warming-up process because, even with the water temperature quickly raised to 185°, it does not change the rate at which the oil temperature increases.

The actual temperature of the oil is not as important as the stabilization of the oil temperature.

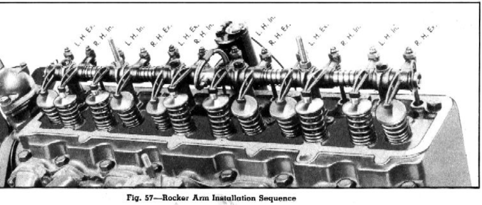

Fig. 57—Rocker Arm Installation Sequence

The expansion or contraction of the valves, rocker arm supports, push rods, cylinder head and cylinder block are relative to this oil temperature. Hence, after the oil temperature is stabilized, these parts have stopped expanding and no change in valve adjustment takes place, as shown in the above table.

Normalizing the Engine

To Normalize the engine, run it at a fast idle—(approximately 600 R.P.M.) and check the oil temperature with a thermometer at the overflow pipe on the valve rocker shaft connector. WHEN A CONSTANT OIL TEMPERATURE IS REACHED FOR A PERIOD OF FIVE MINUTES, THE ENGINE IS NORMALIZED AND READY FOR VALVE ADJUSTMENT.

The important factor is to eliminate all unequal expansion of engine parts before adjusting the valves, and this occurs only after the oil has reached a constant temperature.

Before adjusting the valve clearance, lubricate valve stems to insure free movement of the valves in their guides. Adjust the valve clearance as follows:

Normal Operation	Heavy Duty Operation
Intake .006″ to .008″	.010″
Exhaust .013″ to .015″	.020″

On severe truck operations it is advisable to adjust the valves to the high setting.

Sometimes, a truck is brought into the Service Station to have the valves adjusted after having been driven for some distance and the engine is already warm. However, the oil temperature may vary considerably, depending on the type of operation and the length of time the engine has been subjected to such operation. On jobs of this kind considerable time may be saved by following the procedure described below:

Run the engine at a fast idle (approximately 600 R.P.M.) and check the oil temperature with a thermometer at the overflow pipe on the valve rocker shaft connector. When a constant oil temperature is reached for a period of five minutes, the engine is normalized and ready for valve adjustment.

The stabilization of the oil temperature may take place between 150° and 225° depending on how the truck has been driven before being brought into the service station. From the foregoing it can be readily seen that the time necessary to run the engine may vary from 30 minutes in cases where the engine is started up from a cold condition, to 5 minutes in cases where the engine has already been in operation, providing the oil temperature is stabilized at the end of the 5-minute period.

INTAKE AND EXHAUST MANIFOLDS

The intake manifold is a "D" shape which results in better atomizing and more even distribution of the fuel to each of the six cylinders. This is another contribution to smooth engine performance.

The exhaust manifold is designed to reduce the back pressure to a minimum. Located on the inside of the exhaust manifold is the thermostatically operated heat control valve.

The thermostatically controlled heat control valve in the exhaust manifold directs the hot exhaust gases against the center of the intake manifold when the engine is cold (Fig. 58-Left). As the engine warms up, the thermostatic spring closes the valve and directs the exhaust gases away from the intake manifold (Fig. 58-Right). This thermostatic control results in the proper temperature of the incoming gases under all operating conditions. The tension of the thermostatic spring is very important—if it is too tight, the exhaust manifold heat will not be turned off the intake heat riser as the engine warms up, with the result that the incoming gases are expanded several volumes and a full charge cannot be forced into the cylinders. This, of course, reduces power and top speed, makes the truck lazy on acceleration, etc. Therefore, it is most important that the thermostatic spring be wound up just enough to slip it over the anchor pin in the manifold and no more. This is approximately ½ turn of the spring, at 70° F.

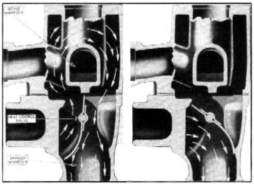

Fig. 58—Manifold Heat Riser

Whenever the manifolds are removed from an engine, the gaskets should be examined to be sure that they are in good condition, as leaky gaskets will make the engine miss. Worn gaskets should be replaced with new ones.

In assembling the manifolds to the cylinder head, the bolts should be drawn up evenly until they are all tight. A special wrench is necessary to properly tighten these bolts.

Engine Mountings

Rubber engine mountings are used at the front and rear to prevent engine vibrations being transmitted to the cab.

The front engine mounting assembly is made up of a shield, bushing and rubber cushion assembly and a metal retainer.

When installing the mounting, the shield is installed next to the engine front end plate. Then install the bolts through the end holes in the rubber mounting, starting the bolts through from the side having the large diameter hubs on the bushings, thread the mounting over the bolts staked into the engine front end plate, install the washers and nuts. Tighten the nuts and install cotter pins. Install the mounting cover. The complete engine with mounting is attached to the frame front crossmember by the two bolts which were installed in the ends of the rubber mounting. After these bolts are inserted through the crossmember, install the washers and nuts.

The rear engine mountings are made up in a unit which consists of two steel stampings with reinforcing plates welded on the inside. Each plate is drilled and tapped for mounting to the frame and engine support bracket. A rubber cushion is located between the two plates and vulcanized to them.

When installing these mountings the plate with the greater width is bolted to the engine support bracket with a bolt and lockwasher, making sure that the dowel on the lower plate of the mounting is toward the front. The mounting is attached to the frame bracket by a spacer, lockwasher and bolt.

CAUTION: When installing the bolt which attaches the rear engine mounting to the frame bracket, make sure the locating dowel in the bottom of the mounting fits into the forward dowel hole in the frame bracket on each side.

ENGINE TUNE-UP

One of the most important operations in the maintenance of an engine is proper tuning of the engine. This operation more than any other determines whether or not the engine delivers the maximum in performance and economy.

Only by performing the following operations and adhering to the limits and clearance specifications are you able to get the performance and economy that have been built into the engine.

Compression

Before making any checks on an engine it should be run for several minutes to warm it up and lubricate the valve mechanism. The compression of the engine should be checked first because an engine with uneven compression cannot be tuned successfully.

1. Remove all spark plugs from the engine. The ignition should be turned off and the throttle valve in the open position.
2. Insert the compression gauge in a spark plug hole and hold it tightly. Crank the engine with the starting motor until the gauge reaches its highest reading, which requires only a few turns of the engine. Repeat the same test on all cylinders and make a note of the compression on each cylinder.

The compression on all cylinders should be 110 pounds or better, and all cylinders should read alike within 5 to 10 pounds for satisfactory engine performance.

Should you have a low compression reading on two adjacent cylinders, it indicates a possible intercylinder leak, usually caused by a leak at a cylinder head gasket.

If the compression readings are low, or vary widely, the cause of the trouble may be determined by injecting a liberal supply of oil on top of the pistons of the low reading cylinders.

Crank the engine over several times, and then take a second compression test. If there is practically no difference in the readings when compared with the first test, it indicates sticky or poorly seating valves. However, if the compression reading on the low reading cylinders is about uniform with the other cylinders, it indicates compression loss past the pistons and rings.

Naturally, the cause of low or uneven compression would have to be corrected before proceeding with an Engine Tune-Up Job.

Spark Plugs

Clean the spark plugs thoroughly, using an abrasive type cleaner. If the porcelains are badly glazed or blistered, the spark plugs should be replaced. All spark plugs must be of the same make and heat range.

Adjust the spark plug gaps at .040", using a round feeler gauge. DO NOT BEND THE CENTER ELECTRODE.

Care must be used when installing the AC-104 10 Millimeter spark plugs or the setting of the gap may be upset. If a tension wrench is used when installing the plugs, the proper tension is 15 foot pounds. If a tension wrench is not available, the following procedure should be used:

Install a new gasket on the plug, screw the plug in finger tight and then tighten with a wrench ½ to ¾ turn.

Battery Test

Connect the negative terminal of a voltmeter to the starting switch terminal and the positive terminal of the voltmeter to a good ground.

Close the starting motor switch and crank the engine for 15 seconds. If the starting motor cranks the engine over at a good rate of speed with the voltmeter reading 5 volts or better, it indicates a satisfactory starting circuit, which includes the condition of the battery terminals and cables. However, if the cranking speed is slow, or the voltmeter reading is under 5 volts, the starting motor, battery, and battery cable terminals should be checked individually to locate the source of the trouble.

Distributor

Remove the spark plug wires from the distributor cap and examine the terminals for corrosion. The wires should also be checked for damaged insulation and the wires for being oil soaked.

Remove the distributor cap and check the cap and distributor rotor for cracks or burned contacts.

Check the automatic advance mechanism by turning the distributor cam in a clockwise direction as far as possible, then release the cam and see if the springs return it to its retarded position. If the cam does not return readily, the distributor must be disassembled and the cause of the trouble corrected.

Examine the distributor points. Dirty points should be cleaned, and pitted or worn points should be replaced. Check the points for alignment, and align them if necessary.

Hand-crank the engine until the cam follower rests on the peak of the cam. Adjust the point gap to .018", using a feeler gauge. This operation must be performed very accurately because it affects point dwell. Hand-crank the engine until the cam follower is located between the cams. Hook the end of a point scale over the movable point and pull steadily on the spring scale until the points just start to open. At this point the reading on the scale should be between 17 and 21 ounces.

Set the octane selector at "zero" on the scale. Reassemble distributor cap and spark plug wires. Make sure that the terminals of the primary wire from the ignition coil to the distributor are clean and tight.

Coil and Condenser

The ignition coil and condenser should be checked following the instructions given by the manufacturer of the testing equipment being used.

Fuel Pump

Remove the filter bowl and screen and wash them thoroughly in cleaning solvent. When reassembling make sure that the cork gasket is in good condition and properly seated. Tighten all fuel pump connections.

Air Cleaner

Remove the air cleaner from the carburetor. Remove the wing nut from the top and remove the cover. Remove the filter element assembly.

CAUTION:—Do not pry this part loose if it sticks. It must be removed by hand because you may damage the filter element flange, which must lie flat against the body to insure a tight seat at this point to prevent air leaks when the cover is assembled.

Empty the oil out of the cleaner and clean out all oil and accumulated dirt. Wash body with cleaning solvent and wipe dry. Wash filter element by slushing up and down in cleaning solvent. Dry thoroughly, either with an air hose or by letting it stand until dry. Fill the body of the cleaner with oil of the proper viscosity.

It is not necessary to re-oil the filter element as this is done automatically when the car is driven.

Reassemble the filter element to the body of the cleaner, being sure that the flange sets flat against the top flange of the body.

Reassemble the cover, making sure that the gasket is clean and in good condition over its entire surface so that a tight seal is obtained at this point. Put on wing nut.

Reassemble the cleaner to the carburetor. The cleaner must be put on tight so that it rests against the carburetor to assure a good seat at this point. Tighten clamp.

Carburetor

Remove the carburetor from the engine. Disassemble and clean all parts thoroughly. Check the condition of the needle valve and seat, main nozzle, low-speed jet, metering rod jet, metering rod, and accelerating pump jet.

Assemble jets and plugs to carburetor body, making sure all gaskets are in place. Set the float level. This should be 3/8" from the outer end of the float to the surface of the cover with the gasket removed. Then check the low level of the float by measuring from the outer end of the float to the surface of the cover with the needle valve in the maximum open position. This measurement should be 7/8".

Assemble the bowl cover to the carburetor. Synchronize the metering rod with the throttle valve on the Carter carburetor according to instructions contained in the Carburetor Section of this Manual.

Reassemble carburetor and air cleaner to the engine.

Manifold Heat Valve

Unhook the thermostatic spring from its anchor pin and check the adjustment. Proper adjustment requires only ½ turn of the spring to slip it over its anchor pin. Should the thermostatic spring be distorted in any way it should be replaced.

Ignition Timing

With the octane selector set at "zero," attach Neon Timing Light KMO-318 to No. 1 spark plug. Start the engine and run it at idling speed. Loosen distributor clamp and rotate distributor body clockwise or counterclockwise until the steel ball in the flywheel lines up with the pointer on the flywheel housing. Tighten the distributor clamp screw.

Valve Adjustment

Start the engine and while it is warming up, the cylinder head bolts, rocker arm shaft support bolts and nuts and the manifold bolts and nuts should be tightened. Where torque wrenches are available the cylinder head bolts should be tightened to 75 to 80 foot pounds, and the rocker arm shaft support bolts to 25 to 30 foot pounds.

Normalize the engine and adjust the valves according to the procedure given in this section of the manual under the heading "Valve Adjustment Procedure."

Install the rocker arm cover, using a new gasket and check for oil leaks.

Idling Adjustment

Adjust the carburetor idle and throttle stop screws in combination with each other to secure the best idling performance. Idling speed should be set at 500 to 550 R.P.M.

Cooling System

Tighten all hose connections and examine for any indications of water leaks. Check the fan belt for proper tension and adjust it if necessary.

Current and Voltage Regulator

Check the adjustment of the Current and Voltage Regulator according to the instructions given in Section 12 of this Manual.

Road Test

After the completion of the above operations, the truck should be road-tested for performance. During this time the octane selector should be adjusted for the grade of fuel being used. For peak performance and maximum gasoline economy, the octane selector should be set to produce a slight "ping" upon accelerating at wide-open throttle.

ENGINE TROUBLES AND CAUSES

Lack of Power

1. Low or Poor Compression.
2. Ignition System Defective—See "Distributor" Section.
3. Carburetor or Fuel Pump not Functioning Properly—See "Fuel System" Section.
4. Air Cleaner Restricted.
5. Low Octane Fuel.
6. Overheating—See "Cooling System."
7. Improper Grade and Viscosity of Oil.

Poor Compression

1. Incorrect Valve Lash.
2. Leaky Valves.
3. Valve Stems or Lifters Sticking.
4. Valve Stems or Guides Worn.
5. Valve Springs Weak or Broken.
6. Valve Timing Incorrect.
7. Cylinder Head Gasket Leaking.
8. Piston Rings Broken, Worn or Stuck.
9. Pistons or Rings Improperly Fitted.
10. Piston Ring Grooves Worn.
11. Cylinder Scored or Worn Excessively.

Excessive Cylinder and Piston Wear

1. Improper Grade and Viscosity of Oil.
2. Lack of Oil.
3. Dirty Oil.
4. Overheating—See "Cooling System."
5. Piston Improperly Installed and Fitted.
6. Piston Rings Not Properly Fitted to Piston Groove and Cylinder Wall.
7. Piston Rings Stuck in Piston Grooves or Broken.
8. Air Cleaner Not Clean, Allowing Dirt to Enter Combustion Chamber.
9. Carburetor Fuel Mixture too Rich.

Crankshaft Bearing Failure

1. Crankshaft Bearing Journal Out-of-Round.
2. Crankshaft Bearing Journal Rough.
3. Crankshaft Oil Passage Restricted.
4. Bearings Loose.
5. Crankshaft or Bearings Out-of-Alignment.
6. Lack of Oil.
7. Low Oil Pressure.
8. Improper Grade and Viscosity of Oil.

Connecting Rod Bearing Failure

1. Crankshaft Surface Rough.
2. Dipper Improperly Installed, Improper Oil Trough or Dipper Height, Oil Nozzle Improperly Aimed.
3. Bearings Loose.
4. Bent Connecting Rod.
5. Lack of Oil.
6. Low Oil Pressure.
7. Improper Grade and Viscosity of Oil.

Burned Valves and Seats

1. Improper Valve Lash.
2. Weak Valve Springs.
3. Improper Valve Timing.
4. Excessive Carbon Deposits Around Seat and Valve Head.
5. Valves Sticking in Guides.
6. Improper Type Valves—Use Genuine Parts.
7. Valve Head too Thin Causing Hot Sections.
8. Valve Seats too Narrow.
9. Fuel Mixture Flow Restricted.
10. Overheating—See "Cooling System."
11. Rocker Arm Stuck, Holding Valve Open.

Valves Sticking

1. Incorrect Valve Lash.
2. Insufficient Clearance Between Valve Stem and Guide.
3. Valve Springs Weak or Broken.
4. Valve Stems Scored or Dirty.
5. Valve Lifters Sticking.
6. Use of Fuel with High Gum Content.

Overheating

1. See "Cooling System."
2. Improper Grade and Viscosity of Oil.
3. Fuel Mixture too Lean.
4. Air Cleaner Restricted.
5. Ignition System Defective—See "Distributor" Section.
6. Valve Timing too Early.
7. Damaged Thermostat.
8. Hose Connections Restricted.

Excessive Oil Consumption

1. Piston Rings Broken, Worn or Stuck.
2. Piston Rings Improperly Fitted.
3. Piston Ring Oil Return Holes Clogged with Carbon.
4. Cylinder Bore Out-of-Round or Excessive Taper.
5. Cylinder Bore Scored or Badly Worn.
6. Engine Running too Cool.
7. Oil Level too High.
8. Oil Leaks at Gaskets and Seals.

Popping, Spitting and Spark Knock

1. Manifold Heat Control Spring Not Properly Installed.
2. Defective Ignition System—See "Distributor" Section.
3. Carburetor Not Properly Adjusted—See "Fuel System" Section.

4. Valve Lash Adjusted too Close.
5. Exhaust Valve Head too Thin Causing Hot Sections.
6. Excessive Carbon Deposits in Combustion Chamber.
7. Weak Valve Springs.
8. Hot Spot in Cylinder Head, Usually Caused by Clogged Water Passages.
9. Valves Not Seating Properly.
10. Valve Timing Early.
11. Inferior Grade of Fuel.
12. Spark Plugs Glazed; Clean or Replace.

Engine Surge or Roll — At Idling Speed

1. Improper Carburetor Idle Adjustment.
2. Improper Governor Adjustment.

Engine Surge or Roll — At High Speed

1. Improper Governor Adjustment.

TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling an engine:

Tool Number	Description
J-1000	Main Bearing Boring Machine
J-946	Camshaft Bearing Service Tool Set
T-126-R	Crankshaft Gear Puller—¾" Screw
J-971	Camshaft Gear Press Plate
J-969-2	Oil Pan Trough Depth Gauge
J-969-1	Oil Pan Target
J-969-3	Oil Line Nozzle Depth Gauge
J-1287	Harmonic Balancer Driver and Puller
KMO-318	Timing Light
J-793-3	Faucet Assembly
J-793-2	Oil Line Setting Tool
J-965	Piston Reamer and Fixture
KMO-357	Piston Inserter
KMO-964	Inside-Outside Caliper
J-995	Timing Gear Cover Oil Seal Driver
J-966	Timing Gear Cover Centering Gauge
J-982-A	Cylinder Head Holding Fixture
J-267	Valve Guide Remover
J-1089	Valve Guide Replacer—Intake
J-1090	Valve Guide Replacer—Exhaust
KMO-122	Valve Guide Hole Cleaner
KMO-105-B	Valve Seat Cutter Set
KMO-341	Valve Guide Reamer (Roughing)
KMO-343	Valve Guide Reamer (Finishing)
U-15	Valve Spring Tester
N-344	Cylinder Head Guide Pin Set
J-1313	Torque Wrench
KMO-187-1	Torque Wrench Adapter
KMO-187-10	Torque Wrench Adapter

ENGINE SPECIFICATIONS

Type	Valve-in-Head
Number of Cylinders	6
Bore	3 9/16"
Stroke	3 15/16"
Piston Displacement	235.5 cu. in.
Compression Ratio	6.62:1
Horsepower	SAE 30.4
Firing Order	1-5-3-6-2-4
Maximum Torque	192 ft. lbs.
Cylinder Block:	
Bore Size	3.562" - 3.564"
Bore Out-of-Round	.0005" Max.
Taper	.0005" in Bore Length
Cylinder Head:	
Torque Wrench Pull (Foot lbs.)	75 - 80
Crankshaft:	
Number of Bearings	4
Bearing Journal Diameter:	
Front	2.6835" - 2.6845"
Front—Intermediate	2.7145" - 2.7155"
Rear—Intermediate	2.7455" - 2.7465"
Rear	2.7765" - 2.7775"
Connecting Rod Journal	2.311" - 2.312"
Thrust Taken	Rear Intermediate
End Clearance	.004" - .007"
Crank Pin Out-of-Round	.001" Max.
Run-Out—At Intermediate Journal	.002" Max.
Crankshaft Main Bearing:	
Bearing Clearance	.0015" - .0025"
Torque Wrench Pull (Foot lbs.)	(With threads oiled) 100 - 110
Connecting Rod:	
Center to Center Length	6 13/16
Upper Bearing	Locked on Pin
Lower Bearing	Cast Babbitt
Lower Bore	2.3130" - 2.3135"
Connecting Rod Bearing—Lower:	
Bearing Clearance	.0004" - .0009"
End Clearance	(Controlled by Upper Half of Bearing) .004" - .011"

Torque Wrench Pull (Foot lbs.)	(With Threads Oiled) 40 - 45
Clearance Between Piston and Cylinder Bore	(Refer to Fitting Instructions in Engine Section) .0017" - .0023"
Fit Piston with Feeler Shim on Thrust Side at Bottom and 90° opposite Piston Pin Holes	Pass on .002" Feeler ½" Wide Hold on .003" Feeler ½" Wide
Oversize Pistons Available	.003" - .010" - .020" - .030" - .040"
Piston Pin Hole	Slip Fit
Ring Groove Width:	
Compression	.1255" - .1265"
Oil	.1885" - .1895"
Piston Pin:	
Diameter	.8645" - .8650"
Oversize	.003" - .005" - .010"
Compression Ring:	
Quantity	2
Type	Plain
Width	.1235" - .1240"
Gap	.005" - .015"
Ring and Groove Clearance	.0015" - .0030"
Oil Ring:	
Quantity	1
Type	Drilled
Width	.1860" - .1865"
Gap	.005" - .015"
Ring and Groove Clearance	.002" - .0035"
Camshaft:	
Number of Bearings	4
Bearing Journal Diameter:	
Front	2.0282" - 2.0292"
Front—Intermediate	1.9657" - 1.9667"
Rear—Intermediate	1.9032" - 1.9042"
Rear	1.8407" - 1.8417"
Run-Out at Intermediate Bearing	.002" Max.
Thrust Taken	Front
Thrust Plate Thickness	.184" - .189"
Camshaft End Clearance	Free to .003"

Camshaft Bearing:		
Diameter—Line Ream:		
Front		2.0307" - 2.0317"
Front—Intermediate		1.9682" - 1.9692"
Rear—Intermediate		1.9057" - 1.9067"
Rear		1.8432" - 1.8442"
Bearing Clearance		.002" - .004"
Intake Valve:	(Normal Operation)	(Heavy Duty Operation)
Lash—Hot	.006" - .008"	.010"
Seat Angle		30°
Diameter Head		1 41/64"
Length—Over-all		6.205" - 6.235"
Stem Diameter		.3407" - .3417"
Guide Ream		.3427" - .3437"
Stem to Guide Clearance		.001" - .003"
Intake Opens		3° B.U.D.C.
Intake Closes		35° A.L.D.C.
Intake Period		218°
Width of Seat (In Head)		3/64" to 1/16"
Exhaust Valve:	(Normal Operation)	(Heavy Duty Operation)
Lash—Hot	.013" - .015"	.020"
Seat Angle		30°
Diameter Head		1 15/32"
Length—Over-all		4.839" - 4.869"
Stem Diameter		.3397" - .3407"
Guide Ream		.3427" - .3437"
Stem to Guide Clearance		.002" - .004"
Exhaust Opens		46° B.L.D.C.
Exhaust Closes		5° A.U.D.C.
Exhaust Period		231°
Width of Seat (In Head)		1/16" - 3/32"
Valve Lifter:		
Diameter		.989" - .990"
Clearance—Block to Lifter		(Selective Fit) 0 - .001"
Valve Spring:		
Free Length		2 1/8"
Lbs. Pressure at 1 13/16"		55 lbs.
Lbs. Pressure at 1 1/2"		128 lbs.

Valve Rocker:	
Rocker Shaft Diameter	.7910" - .7917"
Rocker Arm Diamond Bored (After Granodizing)	.7922" - .7932"
Clearance—Rocker Arm to Shaft	.0005" - .0022"
Timing Gears:	
Backlash	.002" - .005"
Crankshaft Gear:	
Material	Leaded Steel
Teeth	27
Run-Out	.003"
Camshaft Gear:	
Material	Steel Hub—Gear Bakelite—Fabric Composition
Teeth	54
Run-Out	.004"
Oil Pump:	
Lbs. Pressure at 2000 R.P.M.	14 lbs.
Gear Backlash	.002" - .0085"
Gear Width	.812" - .814"
Diameter:	
Housing Bore	.5585" - .5605"
Drive Shaft	.5575" - .5580"
Driven Gear Shaft	.5565" - .5570"
Drive Gear—Bore	.556" - .557"
Driven Gear—Bore	.5575" - .5585"
Clearance Between:	
Drive Shaft and Housing	.0005" - .0030"
Drive Gear to Shaft	.0005" Press - .0020" Press
Driven Gear to Shaft	.0005" - .0020"
Gear to Housing (Radial)	.003" - .008"
Gear to Housing Lower Edge	.002" - .008"
Relief Valve to Housing	.002" - .009"
Pressure Relief Spring:	
Free Length	59/64"
Pressure at 19/32"	109 oz. ±5 oz.
Valve Opens at	15 lbs.
Oil Filter:	
Make	AC No. 1595178
Model	Military Standard Jr.
Replacement Element	Part No. 1595222

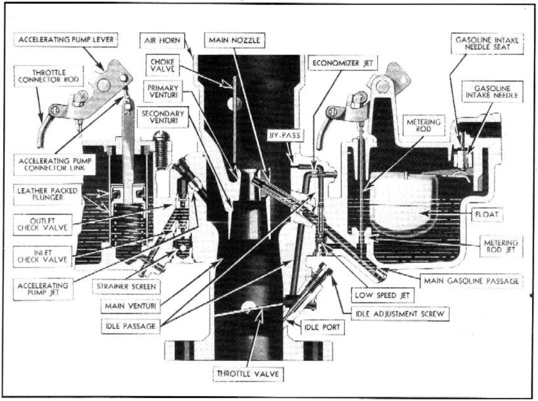

Fig. 1—Diagrammatic View of Carburetor

CARBURETOR

The down-draft carburetor contributes to the smooth, quiet operation and power of the Chevrolet valve-in-head engine. Down-draft, as its name implies, eliminates the necessity of lifting air and gasoline from the carburetor, thus improving the breathing ability of the intake system without affecting its flexibility.

This carburetor embodies a principle which employs three venturis, one located above and two below the level of the fuel in the float chamber. This triple venturi has the effect of increasing the suction on the first or primary venturi, causing the nozzle to start delivering fuel at very low air speeds. The nozzle enters the primary venturi at an angle, discharging upwardly against the air stream. This angle secures an even flow of correctly proportioned and finely atomized fuel.

The fuel thus atomized in the primary venturi is kept centrally located in the air stream by the surrounding blanket of air passing into the second venturi and this process is repeated by the air in the main venturi. By this means, the fuel is carried to the cylinders in a more perfectly atomized condition. This insulated atomization results in increased smoothness of operation at both low and high speeds.

The mixture quality is controlled by a metering rod which operates within the metering rod jet, and is operated by the throttle lever. There are two steps of different diameters on this metering rod. The large diameter, or economy step, is tapered and controls the fuel flow to about seven-eights throttle, when the smaller diameter, or power step, becomes effective, giving full power for either high speed or hard low speed pulling. By this simple means, both maximum power and greater economy can be had without changing the carburetor adjustment. Fig. 1 shows the diagrammatic view of the carburetor showing the various passages.

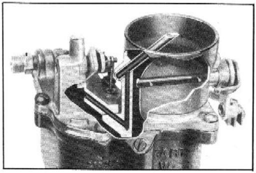

Fig. 2—View Showing Balance Passages

This carburetor is of the "Balanced" type which maintains proper air pressure ratio between the air intake and the fuel bowl. With this arrangement, the restriction of the air cleaner in various stages of cleanliness has a minimum of influence on the air fuel ratio. Fig. 2 shows the balance passages in cross section.

The choker valve is connected to the choker lever through a light spring. This arrangement prevents overchoking.

The accelerating pump is of the pneumatic type and consists of a cylinder with a plunger containing an air bell, and two check valves, one on the inlet and one on the outlet side. See Fig. 1.

OPERATION

Starting

With the choke valve in closed position when starting, suction from the down stroke of the piston draws a small amount of air past the choke valve and it is mixed with the gasoline drawn from the main nozzle, forming a rich mixture for easy starting. (Fig. 3.)

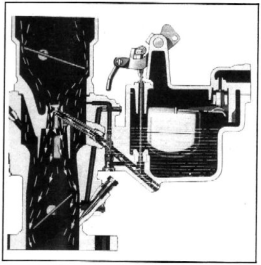

Fig. 3—Operation During Starting

When the engine starts, the incoming rush of air through the carburetor overcomes the tension of the light valve spring and the valve automatically seeks the correct position to provide the proper mixture and prevent overchoking.

Idling

At idling speed the throttle valve is closed, and the suction from the down stroke of the piston is concentrated on the idling port. This suction is applied to the low speed passage in the carburetor body and results in air being drawn in through the by-pass hole in the carburetor body. The air is then swept over the top of the low speed jet, lifting gasoline from the jet. The gas and air mixture then passes through the economizer and down the low speed passage to the idling ports, where it is discharged in the throat of the carburetor and thence through the manifold to the cylinders. This operation is illustrated in Fig. 4.

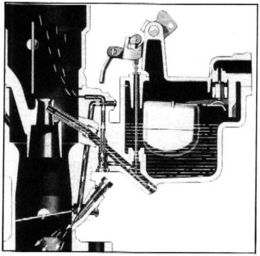

Fig. 4—Operation During Idling

As the throttle valve starts to open, the idling port above the throttle valve is uncovered and increases the suction on the low speed circuit, permitting it to furnish the necessary fuel mixture for this speed.

Accelerating Pump

As the throttle is closed, the accelerating pump piston is drawn upward by the accelerating pump lever, displacing the cylinder. This results in closing the outlet check valve and opening the inlet check valve. Gasoline then flows from the bowl through

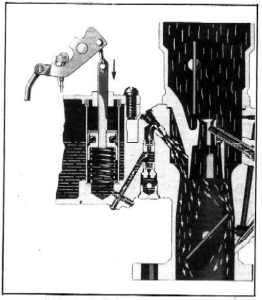

Fig. 5—Accelerating Pump Operation

the inlet check valve and into the pump cylinder. When the throttle is opened quickly, the pump plunger is pushed down in the cylinder by its link connection to the pump lever, compressing the air above the gasoline in the cylinder. This pressure closes the inlet check valve and opens the outlet valve. The gasoline then flows from the cylinder through the outlet valve and accelerating pump jet into the main venturi where it meets and mixes with the air being drawn in through the air horn, forming the gas and air mixture for acceleration. Fig. 5 illustrates the accelerating pump operation.

Low Speed

At low engine speed the throttle is partially open, and suction from the down stroke of the piston draws air in through the air horn. The air, in passing through the main venturi, increases in velocity with the result that the suction is increased in the secondary venturi. The increased air speed through the secondary venturi in turn steps up the suction on the primary venturi and thereby increases the air speed in the primary venturi. The air, passing through the primary venturi, draws gasoline from the main nozzle where it is mixed with the air passing through the primary, secondary and main venturi, forming a finely atomized mixture which then passes to the manifold and cylinders (Fig. 6).

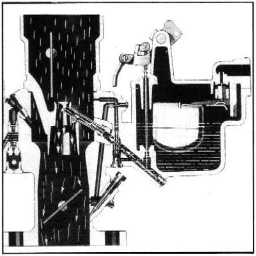

Fig. 6—Operation During Low Speeds

High Speed

The operation at higher speeds is similar to the low speed operation with the exception of raising the metering rod in the metering rod jet. This is equivalent to increasing the size of the jet and thereby furnishes the additional gasoline required for high speeds and wide open throttle power operation.

Adjustments

The carburetors are carefully tested and adjusted to the engine, before leaving the factory. Too often adjustments are made on the carburetor, when in reality, something else is causing uneven running, or the engine has not thoroughly warmed up.

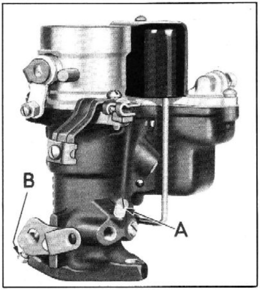

Fig. 7—Idle Adjustment

There are two adjustments on the carburetor, one for idling mixture and the other for idling speed. Both of these adjustments should be made together.

To adjust the idling mixture, proceed as follows: Open the idle adjustment screw, "A," Fig. 7, 1½ turns. Start the engine and let it run at idling speed. Then adjust the idle and throttle stop screw, "B," Fig. 7, in combination with each other to secure the best idling performance. Idling speed should be set at 500 to 550 R.P.M.

Float Level

Float level is one of the most important adjustments on the carburetor. This adjustment is checked by measuring from the machined surface on the

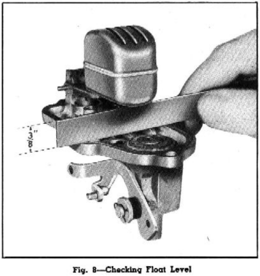

Fig. 8—Checking Float Level

underside of the bowl cover (with the gasket removed) to the top of the float. This measurement should be 3/8". The gauge shown in Fig. 8 is a convenient tool for making this check.

If the float level must be reset, it can be done by bending the lip that comes into contact with the gasoline intake needle. Bending the lip up will lower the float level and bending it down will raise it. Only a slight bend is necessary to change the float level.

Check the low position of the float. It should be 7/8" from the top of the float to the machined surface on the bowl cover. Bend the ears on the float arm to secure this measurement.

Metering Rod

The metering rod, which controls the amount of gasoline passing through the jet, can be changed to meet the various climatic, fuel or driving conditions.

These various sizes are available through the parts warehouses and are marked with their size below the eye of the metering rod.

The metering rods are marked as follows:

Standard 67-46
Lean 68-49

Whenever a new metering rod is to be installed or the metering rod has been removed from the carburetor, the metering rod gauge should be used to check the relationship between the metering rod and throttle valve. This gauge can be procured from any Chevrolet Parts Warehouse under part number 600996.

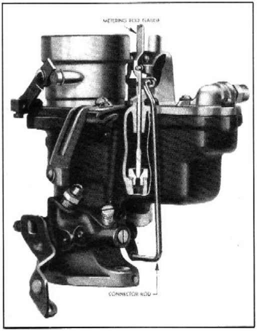

Fig. 9—Metering Rod Gauge

To properly synchronize the metering rod with the throttle valve, proceed as follows, Fig. 9.

1. Remove the metering rod and disconnect the connector rod from the lever.
2. Back off throttle stop screw until throttle valve is closed tightly.
3. Install metering rod gauge, allowing the metering rod pivot pin on the lever to rest on the gauge.
4. Bend connector rod at throttle valve end until connector rod will enter hole in the lever freely.
5. Remove metering rod gauge, assemble metering rod and readjust the throttle stop screw.

REPAIR OPERATIONS

Disassembly

The following instructions cover the repair operations on the Down-draft Carburetor:

1. Remove the dust cover from the carburetor body.
2. With the throttle valve in the open position, remove the stamped retainer from the accelerating pump end of the connector rod, by pushing in on the end of the retainer and turning it 90 degrees. Then remove the anti-rattle spring.
3. Disconnect the metering rod spring and remove the metering rod.
4. Remove the spring retainer from the accelerator pump connector link and remove the link.
5. Remove the four bowl cover screws and remove the bowl cover. Then disassemble the float and needle valve from the cover.
6. Remove the accelerating pump plunger, plunger spring and metering rod jet.
7. Loosen the three air horn to carburetor body screws. Remove the main nozzle passage plug. Remove the main nozzle screw plug. Then, using a screwdriver, reach down through the air horn and press on the "D" section of the main nozzle—this will force the main nozzle out of the "D" section in the primary venturi.

   CAUTION—Do not press on the end of the main nozzle.

   Remove the air horn screws and air horn.
8. Remove the low speed jet.
9. Remove the passage plug and screen for the accelerating pump check valves. Then remove the inlet and outlet valves.
10. Remove the passage plug for the accelerating jet, then remove the jet.
11. Remove the idle adjusting screw and the idle port passage plug.

    In most cases, it will not be necessary to remove the choke valve or throttle valve.

Inspection

1. Wash all parts in clean gasoline or other cleaning solvent.
2. Check the idle ports and first by-pass for carbon deposits. Then blow out all drilled passages with compressed air.
3. Check the operation of the choke mechanism. If necessary it may be disassembled by removing the two screws which retain the choke valve.

   NOTE—These screws are upset on the underside of the valve shaft to prevent them from loosening. Therefore, it is recommended the upset portion be filed off before attempting to remove them.

The choke lever and spring may be removed by first removing the snap ring which retains the lever to the boss on the air horn.

4. Inspect the main nozzle for burrs on the end fitting into venturi. Examine the small air bleed holes in the nozzle and blow out any carbon deposits. Blow out the low speed jet and make sure the metering hole is clean.
5. Check the operation of both the inlet and outlet check valves. Inspect the accelerating pump jet to make sure it is clean.
6. Inspect the accelerating pump plunger. If the leather or its expanding spring are damaged in any way, the plunger assembly should be replaced.
7. Inspect the metering rod jet and metering rod for wear or damage.

Reassembly

When reassembling the carburetor, it is recommended that all paper and copper gaskets be replaced.

1. If the throttle valve has been removed, care must be used to make sure the letter "C" stamped on the valve is toward the idle port when reassembling as shown in Fig. 10.

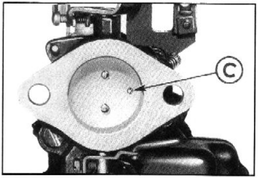

Fig. 10—Correct Assembly of Throttle Valve

2. If the choke valve assembly has been removed, the valve must be assembled to the shaft with the letter "C" stamped on the valve toward top of air horn.
3. Assemble the air horn loosely to the carburetor body, making sure the small gasket is in place at the balance passage.
4. Assemble the copper gasket on the main nozzle, (4) Fig. 11. Hold the carburetor with the air horn down, line up the flat part of the "D" section on the nozzle with that in the primary venturi and drop the nozzle (5) into the opening. Install the nozzle screw plug (3) and tighten it securely. Tighten the three air horn screws. Install the main nozzle passage plug (1) using a new copper gasket (2).
5. Install the low speed jet (13) and gasket (12) in the carburetor body, then again remove the jet and check the bearing on the top end of the jet. If there is a complete bearing around the top of the jet indicating a full seat, it may be reinstalled. If the bearing is incomplete, a new jet should be installed. See Fig. 12.

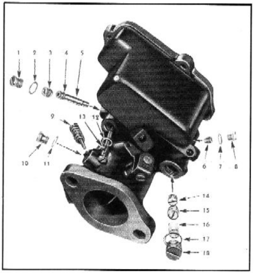

Fig. 11—Down-draft Carburetor Valves and Jets

1—Passage Plug
2—Passage Plug Gasket
3—Nozzle Screw
4—Main Nozzle Gasket
5—Main Nozzle
6—Pump Jet
7—Passage Plug Gasket
8—Passage Plug
9—Idle Adjusting Screw and Tension Spring
10—Passage Plug
11—Passage Plug Gasket
12—Low Speed Jet Gasket
13—Low Speed Jet
14—Pump Outlet Check Valve
15—Pump Inlet Check Valve
16—Pump Strainer Screen
17—Passage Plug Gasket
18—Pump Screen Retainer and Passage Plug

6. Install the outlet and inlet check valves (14) and (15), Fig. 11, in the carburetor body. Then install the screen (16), passage plug (18) and gasket (17). Install the accelerating pump jet (6), plug (8) and gasket (7).
7. Install the metering rod jet and gasket. Place the accelerating pump spring spring in the cylinder. Slip the accelerating pump plunger assembly sleeve over the leather, then with the assembly sleeve centered over the cylinder, push the pump plunger into the cylinder.

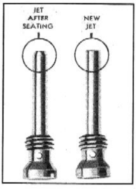

Fig. 12—Low Speed Jet

8. Install the needle valve and seat in the bowl cover, then install the float and lever pin.
9. With the cover turned upside down, check the float level by measuring from the cover to the float. This distance should be ⅜". See Fig. 8.

CAUTION—When making float level adjustments, do not press on the float proper.

Check the low position of the float by measuring from the cover to the top of the float. This

distance should be 7/8". Adjustment may be made by bending the two stops with a small pair of pliers.

10. Install a new accelerating pump cylinder gasket to the bowl cover. Then install the cover to the bowl, using a new gasket.
11. Assemble the accelerating pump plunger link and lock it in place with its spring retainers.
12. Assemble the throttle connector rod to the accelerating pump arm, then install its anti-rattle spring and retainer.
13. Synchronize the metering rod with the throttle valve as explained under the heading, "Adjustments—Metering Rod."
14. Install the metal metering rod hole cover on the metering rod, then install the metering rod and hook metering spring around the rod.
15. Install the idle adjusting screw. Turn the screw in until it seats and then back it off 1½ turns. Install the idle port passage plug.
16. Lubricate the felt washer on the accelerating pump lever shaft with a few drops of engine oil. Install the dust cover.

The carburetor is now ready to install on the engine.

FUEL PUMP

The fuel pump, Fig. 13, is of the diaphragm type and is attached to the crankcase and is operated from an eccentric on the camshaft.

The diaphragm is composed of several layers of specially treated cloth which is impervious to gasoline and benzol. The cloth material is held between two metal discs and is pushed upward by a pump spring, and downward by the arm on camshaft. This diaphragm, in its downward movement, causes a vacuum in the pump chamber and fuel is drawn in through the glass bowl and strainer to fill this vacuum. The upward movement of the diaphragm forces fuel to the carburetor.

The repeated movement of the diaphragm is possible, indefinitely, without injury, due to the extreme flexibility of this material. Further, the movement of the diaphragm occurs only when the carburetor needs fuel. When the carburetor needs fuel, this movement is directly proportional to the amount of gasoline used by the engine. This means that in practically all normal driving conditions this diaphragm is pulsating in a movement of a few thousandths of an inch.

This movement is controlled by linkage because, when the diaphragm is in the depressed position, due to sufficient fuel in the carburetor, the up and down movement of the fuel pump link ceases and the rocker arm spring keeps the rocker arm in contact with the eccentric on the camshaft.

The fuel pump has a large reservoir and surge chamber. The glass filter bowl is clamped to the cover assembly, making it a simple matter to detect the presence of sediment in the fuel pump. The inlet and outlet valve assembles are interchangeable, and each assembly is a self-contained unit made up of a valve cage, a fibre valve, and a valve spring. Both valve assemblies are held in place by a valve retainer, permitting easy and speedy removal of the assemblies.

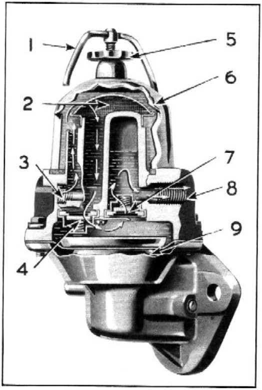

Fig. 13—Fuel Pump Cross-Section

1—Bowl Retainer
2—Filter Screen
3—Inlet
4—Inlet Valve
5—Bowl Retainer Nut
6—Sediment Bowl
7—Outlet Valve
8—Outlet
9—Diaphragm

Disassembly of the Fuel Pump

1. Remove the filter bowl, screen, top cover screws and top cover assembly.
2. Raise the edge of the diaphragm and, using a thin-bladed screwdriver, lift the spring and oil seal over the edge of the boss in the fuel pump body.
3. Unhook the diaphragm from the link by pressing down and away from the rocker arm side.
4. Remove the valve assembly retainer screws and remove the valve retainer.
5. Remove the valve assemblies and gaskets, noting that the inlet valve is assembled in the cover so that the valve opens downward, the valve spring being visible at the bottom of the valve cage. The outlet valve is assembled in the cover so that the valve opens upward, the valve spring not being visible when the valve is assembled in the cover in this position.
6. Inspect the valves to make sure they are clean.

Assembling the Fuel Pump

1. Install the oil seal to the diaphragm push rod in the following manner: Assemble the oil seal

spring, upper retainer, two leather seals, and the lower retainer with the convex side out. This is extremely important in order to seal the fuel pump from any oil that might come up from the crankcase.

2. Raise the fuel pump link with a screwdriver, Fig. 14, install the diaphragm spring and hook the diaphragm pull rod over the end of the link.

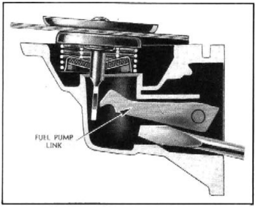

Fig. 14—Installing Diaphragm Spring

3. Install the valve assemblies and paper gaskets, making sure to install the inlet valve with the spring down and the outlet valve with the spring up. The inlet valve is assembled in the cover assembly next to the tapped passage marked "INT."
4. Install the valve retainer with the convex side up, and install the two retainer screws.
5. Assemble the top cover assembly to the fuel pump body and tighten the cover screws alternately and securely.
6. Assemble the screen on the cover and assemble the glass filter bowl to the cover, making sure that the cork gasket is in good condition and that the bowl nut is tight to prevent air leaks at this point.

Air Cleaner

The air which is taken into the carburetor, to mix with the fuel, is thoroughly cleaned in passing through an air cleaner of the oil bath type. This cleaner is filled to the oil level mark with an oil of not less than S.A.E. 50 viscosity in summer months and a lighter oil in winter. Viscosity of the oil used in winter months will be governed by the temperature.

Servicing of this cleaner is an important operation and must be performed as follows:

Remove the air cleaner from the carburetor. Remove the wing nut from the top and remove the cover. Remove the filter element assembly.

CAUTION—Do not pry this part loose if it sticks. It must be removed by hand because you may damage the filter element flange, which must lie flat against the body to insure a tight seat at this point to prevent air leaks when the cover is assembled.

Empty the oil out of the cleaner and clean out all oil and accumulated dirt. Wash body with clean gasoline and wipe dry. Wash filter element by slushing up and down in clean gasoline. Dry thoroughly, either with an air hose or by letting it stand until dry. Fill the body of the cleaner with oil of the proper viscosity.

It is not necessary to re-oil the filter element as this is done automatically when the car is driven.

Reassemble the filter element to the body of the cleaner, being sure that the flange sets flat against the top flange of the body. Reassemble the cover, making sure that the gasket is clean and in good condition over its entire surface so that a tight seat is obtained at this point. Put on wing nut.

Reassemble the cleaner to the carburetor. The cleaner must be put on tight and set down so that it rests against the carburetor to assure a good seat at this point. Tighten clamp.

ENGINE MAXIMUM SPEED GOVERNOR

The Handy Vari-Speed Governor used on Chevrolet truck engines is installed between the carburetor and the intake manifold and automatically governs the maximum speed at which the truck engine may be operated, which in turn limits the maximum speed at which the vehicle may be operated.

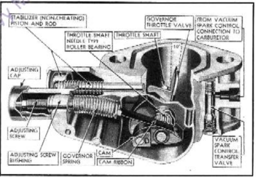

Fig. 15—Engine Governor

The governor, Fig. 15, is operated by the vacuum existing in the intake manifold under varying conditions of engine operation and the flow of air past the governor valve. A shaft carried on needle type roller bearings extends through the body of the governor and this shaft is offset from the center line of the throat. On the shaft is mounted a throttle plate, or throttle valve. The valve is slightly offset on the shaft and in its wide open position is about 10 degrees from vertical as indicated in Fig. 15.

The gas mixture rushing from the carburetor through the governor throat strikes the offset throttle valve and tends to draw it closed. This action is opposed by the governor spring which is attached to the valve shaft through a cam ribbon and cam. By adjusting the pull of this spring, the governor valve can be made to remain open, and then close at a predetermined engine speed. Adjustment of the spring pull is accomplished by changing the number of spring coils operating.

Non-Cheating Stabilizer

When the engine speed is being controlled by the governor, the top side of the governor throttle valve is exposed to atmospheric or comparatively high pressure, while the lower side, being on the suction side, is under low pressure. This difference in pressure is counterbalanced by the governor spring. If the carburetor valve is closed and the restriction becomes the same, or nearly so, as that of the governor throttle valve, a low pressure is then created between the governor and carburetor throttle valves. The force of the governor spring will then tend to open the governor throttle valve creating an increase in engine speed beyond the maximum desired. This condition is known as "cheating" or "stealing." However, this governor is equipped with a "non-cheating" stabilizer as shown in Fig. 15. The stabilizer consists of a spring-loaded piston one side of which is open to outside atmospheric pressure, through an air cleaner as shown in Fig. 16, and the other end open to the area between the two throttle valves. When the pressure in this area drops below outside atmospheric pressure, as it does under the conditions described above, the stabilizer piston is drawn inward, forcing the rod against the governor throttle valve and closes it, thereby preventing the "cheating" or "stealing" of additional engine speed.

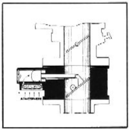

Fig. 16—Action of "Non-Cheating" Stabilizer

Maintenance

The governor should be cleaned at the same time the carburetor is cleaned. Placing the entire governor unit in a bath of gum solvent is the recommended method to follow.

Governor Adjustment

When adjusting the governor for engine speed, changes are always made in the number of operating coils of the governor spring and not by increasing or decreasing the tension of the spring. "A," Fig. 17, shows that the right hand end of the adjusting screw has a large diameter, fine pitch thread. This part of the adjusting screw acts as the spring anchor by being threaded into the first few coils of the spring, "B," Fig. 17. The correct position of the adjusting screw in the spring coils and the correct position of the adjusting screw in the bushing is originally determined by careful test. In making adjustment for engine speed, the adjusting screw is screwed in or out of the spring coils, in this way adding to or subtracting from the effective length in direct relation to engine speed. This is illustrated in "B," Fig. 17, where the adjustment is unscrewed so as to use more coils and in "C" where it is screwed in to reduce the number of coils operating.

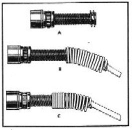

Fig. 17—Governor Spring Positions on Adjusting Screw

To Adjust Maximum Engine Speed

Remove seal and turn adjusting cap, Fig. 15, clockwise to lower engine speed; anti-clockwise to increase engine speed. Replace seal.

One full turn of the adjusting cap will change truck speed approximately 4 to 5 miles per hour.

To Eliminate Surge or "Flat Spot"

In order to eliminate a surge or flat spot in engine operation, it is necessary to change the calibration of the governor spring tension by means of the adjusting screw bushing (Fig. 18). Unless absolutely necessary, it is not recommended that this adjustment be made in the field due to the fine calibration necessary for proper operation. However, if adjustment is to be made, the following instructions should be carefully followed:

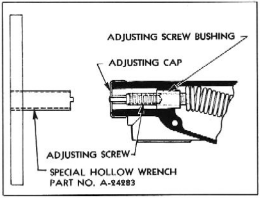

Fig. 18—Points of Governor Adjustment

1. If the governor is too sensitive, or on the point of surging, remove seal. Remove adjusting cap by pulling straight out (do not unscrew from adjusting screw). Place the special hollow wrench, Handy governor part No. A-24283, Fig. 18, in the slots of the adjusting screw bushing. (This hollow wrench is obtainable from the King-Seeley Corporation, Ann Arbor, Michigan.) Turn adjusting screw bushing clockwise ¼ turn. Replace adjusting cap and with it, turn adjusting screw clockwise one full turn. Repeat this adjustment until desired regulation is obtained.
2. If a more sensitive adjustment is desired to eliminate a flat spot, remove the seal. Remove the adjusting cap as described above, and using the hollow special wrench, turn the adjusting screw bushing ¼ turn to the left, or anti-clockwise. Replace adjusting cap and turn the adjusting screw one full turn to the left, or anti-clockwise. Repeat this adjustment until desired regulation is obtained. Replace seal.
3. Each time adjustment of the adjusting screw bushing is made, tap lightly on the end of the hollow wrench so that the bushing will seat properly.

FUEL SYSTEM TROUBLES AND REMEDIES

Symptom	Probable Remedy
Excessive Fuel Consumption	
1. Improper Adjustment	1. Adjust idling and stop screws. 2. Improper float level adjustment. 3. Metering rod not synchronized with throttle valve.
2. Dirty Air Cleaner	1. Clean air cleaner.
3. Fuel Leaks	1. Check carburetor, fuel pump, fuel tank and all lines and connections for leaks.
4. Sticking Controls	1. Choke not returning to off position. 2. Throttle not returning to off position. 3. Manifold heat control thermostatic spring improperly installed.
5. Excessive Idling	1. Stop engine when vehicle will not be moving for long periods.
6. Improper Engine Temperature	1. Refer to Cooling System of this manual.
7. Dragging Brakes	1. Refer to Brake Section of this manual.
8. Tires Under Inflated	1. Inflate to recommended pressure.
9. Engine Improperly Tuned	1. Tune engine—Refer to Engine Tune-Up in this manual
10. Vehicle Overloaded	1. Load only to rated capacity.
Fast Idling	
1. Improper Adjustment	1. Adjust idling and throttle stop screws.
2. Carburetor Controls Sticking	1. Free up controls and lubricate linkage.
Engine Dies	
1. Will not idle below 15 miles per hour	1. Low speed jet or idle passages plugged with dirt (clean carburetor).
Engine Misses	
1. Engine misses on acceleration	1. Improper spark plug adjustment. 2. Improper tappet adjustment. 3. Accelerating pump jet plugged. 4. Accelerating pump check valves sticking or leaking. 5. Flat spot—adjust governor.
Engine Surges	
1. Will not maintain steady speed	1. Adjust governor.

TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling a carburetor.

Tool Number	Description
KMO-268-G	Carburetor Tool Kit
Handy Governor A-24283	Adjusting Wrench

FUEL SYSTEM SPECIFICATIONS

Carburetor:

Type	Downdraft
Make	Carter No. W1-483-S
Part Number	Chevrolet 839500
Model	W1
Pump Jet (Marked)	72
Needle (Marked)	76
Low Speed Jet (Marked)	35
Metering Rod Jet (Marked)	93
Metering Rod (Marked)	67-46
Main Venturi	1¼"
Economizer Jet	54
Float Level	⅜"

Fuel Pump:

Make	AC
Model	AF
Type	Mechanical
Lbs. Pressure	3¾ lbs. Max.
Drive	From Camshaft

Governor:

Make	Handy
Model	V55-113
Type	Velocity

Air Cleaner:

Make	AC
Type	Oil Bath

Service Data

Air Cleaner:

Clean Element and Change Oil as Operating Conditions Require — See Instructions.

Carburetor

Float Level	⅜"
Float Adjustment	See Instructions

COOLING SYSTEM

The efficient operation of the cooling system is beyond a doubt one of the most important factors in the satisfactory performance of an engine. The cooling system has been designed with two purposes in mind; first to carry off a certain amount of the heat created in the engine so that it will not operate at too high a temperature; and second, to maintain the engine heat at that temperature which makes for the most efficient and economical operation of the engine.

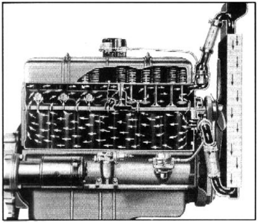

Fig. 1—Water Circulation

Draining Cooling System

To drain the radiator, open the valve located at the bottom of the radiator on the right side. The valve may be reached from the front of the truck.

To drain the cylinder block, open the valve located on the right side of the block toward the rear.

Filling the Cooling System

Close the valves on both the cylinder block and at the bottom of the radiator. Fill the radiator with clean water or during cold weather with an anti-freeze solution. Do not overfill the radiator while anti-freeze solution is being used, because the solution expands when heated and an appreciable amount of liquid would be lost through the overflow. When the engine is stopped and the solution cools off, it contracts and might give the impression that the solution is low. If the solution is visible through the filler neck after the engine has warmed up, it will not be necessaary to add any solution.

Should water be lost from the cooling system and the engine overheats, do not add water immediately—allow the engine to cool down while running at idling speed. Then add water slowly while the engine is still running.

If water is poured into the radiator while the engine is hot, there is danger of cracking the cylinder head.

Water Circulation

While the engine is running, water is drawn from the bottom of the radiator by the water pump and passes from the pump into the two openings in the front of the cylinder block, thence around each cylinder and upward through passages and water nozzles into the cylinder head and around the valve guides and seats. Circulation continues upward through the thermostat to the top of the radiator core. The water then passes down through the passages in the radiator where the air stream cools the water and it is again ready to be circulated through the cooling system. Fig. 1 illustrates the cooling system in cross section.

Water Pump

The water pump (Fig. 2) is of the Ball Bearing Type and requires no care except to check to make certain the air-vent on top of the housing and the drain holes on the bottom do not become plugged with dirt or grease.

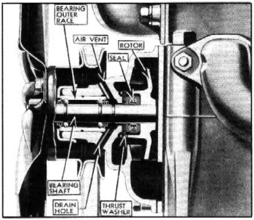

Fig. 2—Water Pump

The shaft and the double row ball bearings are integral and the bearings are packed with a special high-melting point grease at the time of manufacture and require no further lubrication.

The ends of the bearings are sealed to retain the lubricant and prevent dust and dirt from entering.

The shaft and bearing are retained in the housing by a metal cap which is a press fit on the housing. The thrust washer has two lugs which fit into two slots in the end of the rotor. One side of the thrust washer bears against the ground thrust surface of the pump housing and the other against the seal. The rubber seal bears against the machined surface on the inside of the rotor and also against the thrust washer. A coil spring mounted inside, and an integral part of the seal, maintains a constant pressure against the thrust washer and rotor, assuring a positive seal. An air vent on the top of the housing and drain holes on the bottom prevent any water seepage past the thrust washer from entering the bearing.

Water Pump Replacement

Due to the construction of the water pump, it will be serviced only as an assembly.

To replace the water pump, proceed as follows:

1. Drain the radiator and disconnect the hose connection from the pump.
2. Remove the four cap screws which attach the fan blades and remove the fan.
3. Loosen the fan belt adjustment.
4. Remove the four cap screws which attach the pump to the cylinder block and remove the pump.

When replacing the pump, use the above operations in reverse, making sure to readjust the fan belt tension.

Thermostat

To obtain maximum efficiency, operating temperatures of the engine must be held within a certain range. The cooling system is designed to provide adequate cooling under the most adverse conditions; however, it is necessary to employ some device to prevent overcooling during normal operations. This is accomplished by use of a thermostat, which, in addition to maintaining efficient operating temperature, reduces the time required for warm up.

Thermostat Removal and Checking

1. Drain the radiator and disconnect the hose connection from the water outlet.
2. Remove the two cap screws which attach the water outlet to the cylinder head and remove the outlet and thermostat.

If upon removal and inspection the bellows and valve appear to be in good condition, the assembly should be checked. Place the thermostat in a pan or bucket with sufficient water to cover it. Place a thermometer in the container with the thermostat. Heat the water gradually and check the temperature at which the thermostat commences to open. Stir water when taking temperature readings—this should be between 142 and 145 degrees. Do not attempt to repair a thermostat that does not function properly. When reinstalling the thermostat, use a new gasket between the water outlet and cylinder head.

Fan

The four blade fan is bolted directly to the water pump pulley which is driven from the crankshaft by means of a "V" type endless fan belt. The spacing of the fan blades is based on the well known harmonic principle and reduces noise to a minimum. These two pairs of blades set up vibrations of different frequencies, each canceling or dampening out the other.

Fan Belt

Fan belt is of the "V" type, it passes over the crankshaft, water pump and generator pulleys. Provision is made for adjusting the belt tension by a slotted brace attached to generator and cylinder block.

To adjust the fan belt tension, loosen the bolt at the generator end of the brace and rock the generator on its mounting bracket. Moving the generator away from the engine tightens the belt, while moving it closer to the engine loosens the belt. The belt tension may be checked by pushing down on the belt midway between the fan and generator pulleys. The belt is in correct adjustment when it can be pushed 1½ inches below a straight line midway between the fan and generator pulleys.

To replace a fan belt, remove the bolt from the generator brace and rock the generator toward the engine as far as possible. Then thread the new belt over the crankshaft pulley, through the fan blades and over the water pump pulley, then over the generator pulley. Then adjust the belt as described above.

Fan Shroud—¾- and 1½-Ton Trucks

The ¾- and 1½-ton truck radiator may be equipped with a fan shroud which is mounted at the rear of the radiator. Its purpose is to increase the efficiency of the fan in drawing air through the radiator and thereby improving the efficiency of the cooling system, particularly during low speed heavy duty operation. This shroud prevents re-circulation of the hot air from the engine compartment back through the core where it would greatly reduce cooling efficiency.

Radiator Core

The radiator core, used on all truck models, is an all copper, ribbed cellular construction. The core is supported in steel anchorage; bolted in a rugged support that is bolted in turn to the front cross member through a rubber cushion. This construction prevents shocks and frame distortions being transmitted to the core.

A heavy duty radiator core, used on some ¾- and 1½-ton trucks, is equipped with the fan shroud as indicated above. This larger core is especially suitable for more severe truck operations where higher cooling system temperatures are encountered.

Radiator Core Removal

1. Raise the hood and hold it in the up position by its brace.
2. Remove the two bolts which attach the radiator brace to the radiator support, then loosen nuts on brace rod at the dash. Raise the brace rod when core is lifted out.
3. Drain the radiator and remove all hose connections.
4. Remove the four cap screws which attach the fan blades to the water pump pulley and remove the fan blades.
5. Remove the headlamp wiring loom from the clips at the radiator.
6. Remove the cap screws which attach the radiator core to the support. These cap screws are located at the sides of the support.
7. (When heavy duty radiator with fan shroud is used on ¾- or 1½-ton trucks, perform the following operation.) Push the fan shroud to one side and thread it past the bolt which attaches the radiator support brace and then lift it upward.
8. The radiator core may then be removed by lifting it upward away from the support.

Replacement of the radiator core is the reverse of the removal operations.

Care of Cooling System

All hose connections should be inspected regularly for any indication of leakage which might be caused by loose clamps or deteriorated hose connections.

Rust and scale forms in every cooling system—therefore, we recommend that the cooling system be flushed out twice a year, preferably before and after using anti-freeze. There are a number of flushing solutions on the market and the instructions of the manufacturer should be closely followed when using.

When a cooling system is being conditioned, it is good policy to tighten the cylinder head bolts to prevent the possibility of water leaks into the cylinders and lubricating oil.

Anti-Freeze Solutions

The following information is given as a guide to the operator in selecting an anti-freeze and the proportions to use in order to make one gallon of anti-freeze solution for various temperatures.

Alcohol

Denatured alcohol and methanol are used extensively for anti-freezing solutions. The various types of alcohol anti-freeze afford protection against freezing and have the advantage of wide distribution and low first cost.

There are, however, two important disadvantages. Alcohol is lost, especially on warm days and on hard driving, and, unless the solution in the radiator is tested periodically and sufficient alcohol added to replace the loss, the engine or radiator, or both, are likely to be damaged by subsequent freezing. The car finish is softened and damaged by contact with alcohol solutions or vapors. Alcohol accidentally spilled on the finish should be flushed off immediately with a large quantity of cold water without wiping or rubbing.

Directions for preparing Anti-Freezing Solutions from Denatured Alcohol 94% (188° proof) and from "GM Anti-Freeze" (Methanol).

Ethylene Glycol

Ethylene glycol is, in first cost, more expensive than alcohol. Ethylene glycol anti-freezing solutions have the distinct advantage of possessing a somewhat higher boiling point than alcohol anti-freezing solutions and, consequently, may be operated at a higher temperature.

Ethylene glycol has the further advantage that in a tight system only water is required to replace evaporation losses. However, any solution lost mechanically through leakage or foaming must be replaced by additional new solution. Under ordinary conditions, ethylene glycol solutions are not injurious to the car finish.

"GM Ethylene Glycol" is especially treated and compounded for use in the cooling system. Other ethylene glycol preparations are available, but only those containing suitable corrosion inhibitors and compounded for use in automobile cooling systems should be used.

Directions for Preparing Ethylene Glycol Anti-Freezing Solutions from "GM Ethylene Glycol."

Freezing Point	Proportion of "GM Ethylene Glycol" to make one gallon of Anti-Freezing Solution
+10° F.	2 pints "GM Ethylene Glycol," 6 pints water
0° F.	2½ pints "GM Ethylene Glycol," 5½ pints water
—10° F.	3 pints "GM Ethylene Glycol," 5 pints water
—20° F.	3½ pints "GM Ethylene Glycol," 4½ pints water
—30° F.	4 pints "GM Ethylene Glycol," 4 pints water

Other ethylene glycol anti-freezes should be diluted in accord with the instructions issued by the anti-freeze manufacturer.

Freezing Point	Proportion of Denatured Alcohol and Water to make one gallon of Anti-Freezing Solution	Proportion of "GM Anti-Freeze" and Water to make one gallon of Anti-Freezing Solution
+10° F.	2½ pints denatured alcohol, 5½ pints water	2 pints "GM Anti-Freeze," 6 pints water
0° F.	3 pints denatured alcohol, 5 pints water	2½ pints "GM Anti-Freeze," 5½ pints water
—10° F.	3½ pints denatured alcohol, 4½ pints water	3 pints "GM Anti-Freeze," 5 pints water
—20° F.	4 pints denatured alcohol, 4 pints water	3½ pints "GM Anti-Freeze," 4½ pints water
—30° F.	5 pints denatured alcohol, 3 pints water	4 pints "GM Anti-Freeze," 4 pints water

Other alcohol anti-freezes should be diluted in accord with the instructions issued by the anti-freeze manufacturer.

Glycerine

Radiator glycerine, which is chemically treated, in accord with the formula approved by the Glycerine Producers' Association, to avoid corrosion, is satisfactory for use in the cooling system.

Servicing the Cooling System

Before installing anti-freezing solution, the cooling system should be inspected and serviced for winter operation. The system should be thoroughly cleaned and all loose scale and iron rust removed.

Cylinder head gaskets should be tightened, or replaced if necessary, to avoid the possibility of anti-freezing solutions leaking into the engine or exhaust gas blowing into the cooling system. Anti-freeze, or water, mixed with engine oil may form sludge, which will interfere with lubrication and, in some cases, may form varnish-like deposits which will cause gumming and sticking of the moving parts.

It may be advisable to install new radiator and heater hose, especially when ethylene glycol or glycerine anti-freezing solutions are used. Ethylene glycol and glycerine have a tendency to shrink rubber that previously has been swollen by the absorption of water, and leaks may develop.

The water pump seal must be leaktight, not only to avoid loss of liquid, but to prevent air from being drawn into the cooling system. Aeration of the cooling liquid causes foaming and promotes oxidation, which may result in serious corrosion.

After the anti-freezing solution has been installed, the entire system, including the hose connections, cylinder head gasket and pump, should be inspected regularly to insure that no leaks have developed.

The use of additional rust preventives, or inhibitors, is not recommended with "GM Anti-Freeze," "GM Ethylene Glycol," or with other anti-freeze preparations that have been chemically treated or compounded for use in automotive cooling systems.

Testing

Some devices, used for testing anti-freezing solutions, will indicate the correct freezing point only when the test is made at a specific temperature. Other testers, provided with thermometers and tables, indicate the freezing points corresponding to readings made at various temperatures. Disregarding the temperature of the solution, when tested, may cause an error as large as 30° F.

Some testing devices are made to test only one kind of anti-freezing solution. Others have several scales and may be used for the corresponding kinds of anti-freeze.

The freezing point of a solution containing both alcohol and ethylene glycol cannot be determined accurately by means of a hydrometer.

COOLING SYSTEM TROUBLES AND REMEDIES

Symptom and Probable Cause	Probable Remedy
Overheating	
1. Lack of water.	1. Refill system.
2. Fan belt loose.	2. Adjust.
3. Fan belt oil soaked.	3. Replace.
4. Thermostat sticks closed.	4. Replace thermostat.
5. Water pump inoperative.	5. Replace pump.
6. Cooling system clogged.	6. Clean entire system.
7. Incorrect ignition timing.	7. Retime engine.
8. Brakes dragging.	8. Adjust brakes.
9. Manifold heat valve thermostatic spring damaged.	9. Replace spring according to instructions in Section 6.
Overcooling	
1. Thermostat remains open.	1. Replace thermostat.
Loss of Cooling Liquid	
1. Loose hose connections.	1. Tighten all connections.
2. Damaged hose connections.	2. Replace the damaged hose.
3. Leaking water pump.	3. Replace pump.
4. Leaks in radiator core.	4. Remove core and repair leaks.

COOLING SYSTEM SPECIFICATIONS

COOLING CAPACITY (QUARTS) 16

FAN AND WATER PUMP

Type .... Centrifugal

Location .... Front of Cylinder Block

Drive .... Belt

Impeller Location .... Pump Body

Bearings .... Permanently Sealed and Lubricated Ball

Pulley Run-Out Installed . .018″ Total Indicator Reading on Rear Flange and .013″ on Front Flange.

FAN BELT

Deflection .... ¾″

Adjustment .... Moving Generator

THERMOSTAT

Starts to open at .... 140° - 147°

Fully opened .... 170°

FAN BLADES

Diameter .... 18″

Number of Blades 4

RADIATOR CORE

Type .... Ribbed Cellular

Frontal Area .... 405 Sq. In.

Thickness .... 3″

FAN SHROUD

Type .... Box

Location .... Rear Face of Radiator Core

Function . . To prevent recirculation of heated air into radiator core or fan stream.

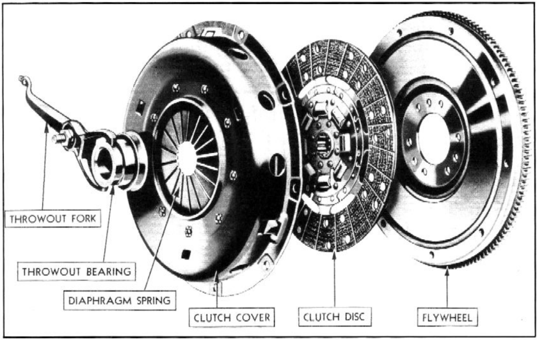

Fig. 1—Layout of Clutch Parts

CLUTCH

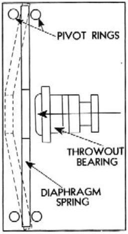

Fig. 2—Diaphragm Spring Action

The clutch is of the single plate dry disc type, designed around a diaphragm spring which has the shape of a dished washer with eighteen tapering fingers pointing inward (Fig. 1). The spring is made from a very high quality steel, carefully heat-treated and shot-blasted to assure long life. The action of the diaphragm spring may be compared to the flexing action of the bottom of an ordinary oil can. By depressing the clutch pedal, the throwout bearing is forced against the diaphragm spring fingers, causing the diaphragm spring to pivot on the pivot rings (Fig. 2).

When the clutch is engaged, the fingers are flat while the entire rim of the diaphragm spring exerts pressure against the pressure plate (Fig. 3). When the clutch pedal is depressed, pressure of the throwout bearing on the inner ends of the fingers causes a diaphragm action and the outer ends of the fingers, near the rim, pivot on the inner pivot ring (Fig. 4). This action causes the rim of the spring

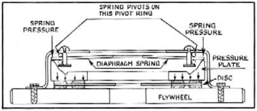

Fig. 3—Engaged Position

and the pressure plate to move away from the clutch disc, disengaging the clutch. When the clutch pedal is released and the throwout bearing no longer contacts the fingers, the "spring" in this material causes the fingers to pivot about the near pivot ring and the rim to bear against the pressure plate.

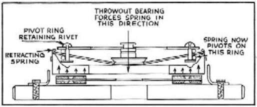

Fig. 4—Disengaged

The clutch disc is a built-up assembly which incorporates cushion springs to pick up the torque load and a torsional vibration dampener built into

the hub. The facings are riveted to the plate with two rows of rivets.

Care

The dry disc type clutch requires very little care during its life. There is only one simple adjustment necessary to maintain clutch efficiency and assure long life. This adjustment is for the amount of free clutch pedal travel before the throwout bearing contacts the clutch fingers.

The ball throwout bearing, in conjunction with the clutch spring makes a simple construction and results in little friction and wear in the mechanism. The bearing is of the sealed type and is packed with a high melting point lubricant which makes further lubrication unnecessary except for packing the inner and outer grooves of the throwout bearing collar when assembling.

REPAIR OPERATIONS

In order to remove the clutch from the flywheel, it is first necessary to remove the transmission from the chassis.

Refer to the Transmission Section for a detailed explanation of this operation.

1. Remove the throwout bearing from the fork.
2. Disconnect pull back spring and adjustment link from clutch fork.
3. Remove the Clutch Fork by pressing it away from its mounting with a screwdriver until the fork snaps loose from the ball.
   The spring retainer may be removed from the groove in the fork by prying one end out at a time with a small screwdriver.
4. Remove the throwout fork mounting from the clutch housing with a 7/8" and 3/4" wrench.
5. Install the Clutch Pilot Tool, K-411, to support the clutch during disassembly. Loosen the six clutch retaining bolts one turn at a time (to prevent cover distortion) until the diaphragm spring pressure is released.

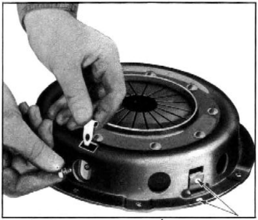

Fig. 5—Removing Retracting Springs

6. Remove the three clutch pressure plate retracting springs, then remove the pressure plate from the Clutch Cover Assembly, Fig. 5. Note the position of the "O" marks on the pressure plate and cover. These must be matched when reassembling in order to maintain proper balance.

NOTE—For ease of servicing, the Clutch Cover, Diaphragm Spring and Two Pivot Rings are built up as an assembly. If inspection shows that there is a defect in any of these parts, it will be necessary to replace the complete cover assembly.

Inspection

The first step in connection with inspection of the clutch is to wash all parts (except the throwout bearing) in cleaning solvent.

1. Inspect the pressure plate and flywheel for any indication of scores on the contact surface. Then check the three drive lugs for burrs and make sure that these lugs move freely in the three slots in the cover. Check the clearance between the lugs and the cover; this clearance should be from .002" to .008".
2. Check the throwout bearing for roughness and free fit on the extension of the transmission main drive gear bearing retainer.
3. Check the run-out of the transmission pilot hole in the clutch housing, Fig. 6. This should be within .008" indicator reading.

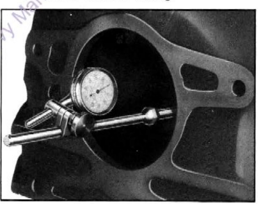

Fig. 6—Checking Transmission Pilot Hole Run-Out

4. Check fit of the ball in the throwout fork; this should be snug without side play, Fig. 7.

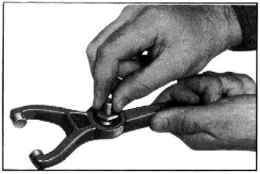

Fig. 7—Checking Fit of Ball in Throw-Out Fork

5. Inspect the clutch disc for worn, loose or oil soaked facings, broken springs or rivets loose on hub. Examine the splines and check to see that they move freely on the splines of the transmission clutch gear. If the splines are worn, the clutch disc should be replaced.

To assure a job that will perform smoothly and effectively for many thousands of miles, all of the foregoing inspections and adjustments must be made.

Pilot Bearing

The clutch pilot bearing is a cage roller type Hyatt Bearing. This bearing requires attention only when the clutch is removed from the car, at which time it should be removed, cleaned, inspected, and replaced, if necessary.

To remove the bearing from the end of the crankshaft, it is first necessary to remove the bearing retainer. Special Puller, K-455-B, is required in order to remove the retainer without damaging the Hyatt Roller Bearing.

This Puller is designed with a small diameter which centers into the clutch pilot bearing. A large aligning bushing on the puller can be moved forward and centered in the transmission pilot hole in the clutch housing so that the retainer will be pulled out straight, and there will be no possibility of the lip of the retainer digging into the bore in the crankshaft. When installing this tool, the tool head should be threaded into the retainer two full turns, and with the clamp in position as shown in Fig. 8, turn the large nut against the clamp, pulling out the retainer.

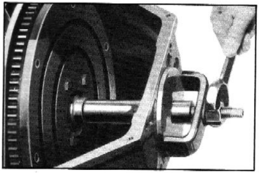

Fig. 8—Pilot Bearing Retainer Remover

The roller bearing may now be removed with the fingers.

Before installing the bearing, it should be packed with a special high temperature grease.

The bearing may then be installed in place at the end of the crankshaft.

The special driver, K-410, shown in Fig. 9 should be used when installing a new retainer.

This driver is constructed with a centering collar which fits in the pilot hole in the housing and has a pilot on its end which centers in the bearing.

In operation a retainer is placed on the end of the driver with the flat side of the retainer toward the bearing and the tool placed into position with the centering collar in the transmission pilot hole

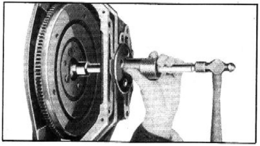

Fig. 9—Installing Clutch Pilot Bearing Retainer

in the flywheel housing. The handle is then moved forward until the retainer begins to enter the hole in the flywheel. Tap the end of the driver lightly with a hammer until the retainer is seated.

Clutch Reassembly

1. Install the throwout fork mounting ball in the clutch housing.
2. Install the pressure plate in the cover assembly, making sure to mate the two "O" marks as indicated by the arrows shown in Fig. 5—one on the driving lug of the pressure plate and the other on the flange of the cover. This must be done in order to keep the clutch in proper balance.
3. Install the three pressure plate retracting springs. (Refer to Fig. 5.) The clutch is now ready to reassemble to the engine.
4. Hand-crank the engine until the "X" mark on the flywheel is at the bottom. Now install the clutch disc, pressure plate, and cover assembly and support them with the clutch pilot tool. Turn the clutch assembly until the "X" mark on the clutch cover registers with the "X" mark on the flywheel. (Fig. 10.) Then install the bolts, tightening them each a turn at a time to prevent distorting the cover as the spring pressure is being taken up. Remove the clutch pilot tool.

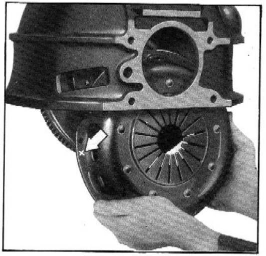

Fig. 10—Installing Clutch Assembly

5. Pack the ball seat in the fork with a small amount of high-melting point grease. Install a new spring retainer in the groove in the Clutch Fork if the old Retainer is worn or damaged. Replace the fork in position in the clutch housing and snap the fork onto the ball.
   CAUTION—Make certain the retainer is installed with the high side of the retainer UP, away from the bottom of the ball bearing, and the open end of retainer on the Horizontal.
6. Lubricate the recess on the inside of the throwout bearing collar and coat the throwout fork groove with a small amount of high-melting point lubricant. (Fig. 11.) Then install the ball throwout bearing assembly to the throwout fork.
   CAUTION—Be careful not to use too much lubricant.

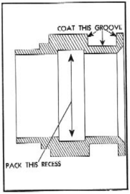

Fig. 11—Lubrication Points on Throw-Out Bearing Collar

7. Install the adjustment link and pull-back spring.
8. The assembly of the transmission and connecting of the universal joint is described in detail in Section 7 of this Manual.

Clutch Pedal Adjustment—½-Ton Trucks

Adjust the clutch pedal to obtain ¾" to 1" free travel of the pedal before the throwout bearing contacts the clutch fingers. (Fig. 12.)

NOTE—Check this free travel with a finger on the pedal and not with the foot as the adjustment is sensitive.

To make the above adjustment, loosen the check nut "A" and turn the adjusting nut "B" (Fig. 12) until the free pedal travel is from ¾" to 1".

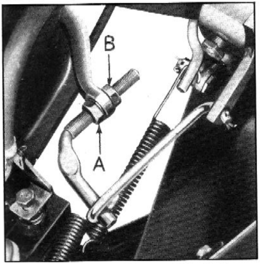

Fig. 12—Clutch Pedal Adjustment—½-Ton Trucks

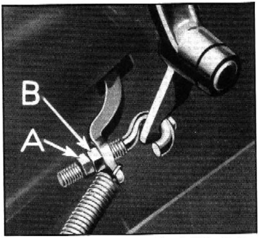

Fig. 13—Clutch Pedal Adjustment—¾ and 1½-Ton Trucks

To make the clutch pedal adjustment on ¾ and 1½-ton trucks, loosen the check nut "A" and turn the adjusting nut "B" (Fig. 13) until the free pedal travel is from ¾" to 1".

CLUTCH AND BRAKE PEDAL MOUNTING

½-Ton Trucks

The pedals and master cylinder unit are mounted in the box section second cross member brace to the left side rail. Each pedal has its own individual shaft riveted and welded to it.

The pedal arms have a pin type bearing welded to its shank, and turning in a bushing in the brake main cylinder housing, which is equipped with a removable plug and holes for lubricating the brake and clutch pedal shafts at the same time. (Fig. 14.)

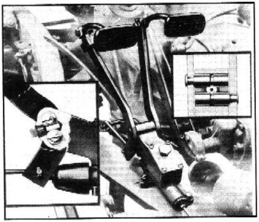

Fig. 14—Clutch and Brake Pedal Mounting—½-Ton Trucks

Each shaft has a groove machined in it to lock the pedals in position. A key fits into the groove and it is retained by a tapered plug.

Disassembly

To disassemble the brake pedal shafts from the brake main cylinder housing, remove the pipe plug and screw the threaded end of the special tool No. J-1441 into the key and remove the key. (Fig. 15.)

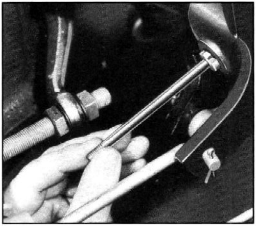

Fig. 15—Removing Clutch and Brake Pedal Key

The pedal shafts can then be removed from the housing.

To replace the pedals, install the pedal shaft in the housing, then insert the key end of the special tool into the opening in the housing to line up the key grooves in the shafts.

Remove the tool and install the key. Assemble the plug and tighten it securely.

Lubrication

The shaft bearings are lubricated during assembly and ordinarily should not require additional lubrication. Should it become necessary to lubricate these bearings remove the brass plug in the center of the key retaining plug and install a lubrication fitting. Lubricate the bushings and replace the plug.

NOTE—Care should be used not to overlubricate the pedal shaft bearing, because the excess grease would drip down on the rubber boot on the front of the brake main cylinder and damage the boot.

Clutch and Brake Pedal Removal
¾ and 1½-Ton Trucks

If it should become necessary to replace either of the bronze bushings in the clutch or brake pedals, proceed as follows:

1. Disconnect the brake pedal pull rod from the brake pedal.
2. Disconnect the clutch pedal adjusting link.
3. Remove the three cap screws attaching the cross shaft to the flywheel housing (one through the shaft and two through the sleeve).
4. The clutch pedal, brake pedal, and cross shaft may then be removed as an assembly.
5. The collar on the end of the cross shaft may be removed by driving out the tapered pin, but this is not normally necessary as the clutch and brake pedals may be removed from the opposite end of the shaft.
6. After removing the worn bushings, new ones may be pressed into place and then reamed to allow from .002" to .003" clearance between the bushing and the shaft.

CLUTCH TROUBLES AND REMEDIES

Symptom	Probable Remedy
Slipping	
1. Improper adjustment.	1. Adjust pedal free travel.
2. Oil soaked.	2. Install new disc.
3. Sticking pressure plate.	3. Check fit of drive lugs on pressure plate in slots in cover (if necessary, replace pressure plate).
4. Worn splines on clutch gear.	4. Replace transmission clutch gear.
5. Lining torn loose from disc.	5. Install new disc.
Grabbing	
1. Oil on lining.	1. Install new disc.
2. Worn splines on clutch gear.	2. Replace transmission clutch gear.
3. Sticking pressure plate.	3. Check fit of drive lugs in cover.
4. Worn shackles.	4. Replace shackle pins and bushings.
5. Loose engine mountings.	5. Tighten or replace mountings.
Rattling	
1. Weak retracting springs.	1. Replace springs.
2. Excessive clearance at driving lugs.	2. Replace pressure plate or cover.
3. Throwout fork loose on ball stud.	3. Check ball stud and retaining spring and replace if necessary.

TOOLS REQUIRED

The following tools, manufactured by the Kent-Moore Organization, or their equivalent are recommended for use when overhauling a clutch:

Tool Number	*Description*
K-445-B	Clutch Pilot Bearing Retainer Puller
K-411	Clutch Pilot Tool
J-1441	Pedal Shaft Aligning Tool
K-410	Clutch Pilot Bearing Replacer

CLUTCH SPECIFICATIONS

Type.......................... Single Dry Plate

FACINGS:

Area—Sq. In. (Total):

½-ton.................... 71.86 Sq. In. Each

¾, 1½-ton................ 104.6 Sq. In. Each

Outside Diameter:

½-ton .... 9⅛"

¾, 1½-ton .... 10¾"

Inside Diameter:

½-ton .... 6⅛"

¾, 1½-ton .... 7"

Thickness:

½-ton .... .132-.138

¾, 1½-ton .... .137-.143

SPRING:

Number and Type........... Single - Diaphragm

CLUTCH THROWOUT BEARING:

Type... Sealed Ball Bearing—Mounted on Sleeve

CLUTCH PILOT BEARING:

Type...................... Hyatt Roller, 99004

SERVICE DATA:

Clutch Pedal Adjustment ¾" to 1" Free Travel before Release Bearing Contacts Clutch Fingers.

Clearance Between:

Driving Lugs and Cover........ .002" -.006"

Splined Hub and Shaft......... .0005"-.0055"

Section 7

TRANSMISSION

THREE-SPEED SYNCRO-MESH TRANSMISSION

½ and ¾-Ton Trucks

The Three-Speed Selective Syncro-Mesh transmission used on ½ ton and ¾ ton trucks, incorporates helical cut gears and splines.

The case is made of cast iron, accurately machined to give proper alignment of the gears and their shafts. All gears are machined from drop forged steel gear blanks and are heat treated for strength and long life. The shafts are machined from high grade steel, are heat treated and ground to close limits. The surfaces of the shifter yokes are "granodized" to prevent scoring during the break-in period and provide greater resistance to wear.

The clutch gear is supported by a heavy duty New Departure ball bearing. The forward end of the main shaft is supported by needle bearings, while the rear end receives its bearing from a New Departure ball bearing. The reverse idler gear is bronze bushed to provide bearing surface, whereas the counter gear is supported at both ends by needle bearings. Fig. 1 shows the construction of this transmission in cross-section, as well as the relative position of the parts.

REMOVAL FROM CHASSIS

½-Ton Truck

1. Remove the floor mat and floor board.
2. Remove the cap screws which attach the universal ball collar to the end of the transmission housing and slip the ball and collar back on the propeller shaft housing.
3. Remove the four cap screws which fasten the universal joint front trunnion bearings to the front yoke. Remove the trunnion bearings and split the universal joint.
4. Remove the bolts which attach the transmission rear support.
5. Remove the bolts which attach the second crossmember to the frame side rails. Then remove the crossmember.
6. Remove the flywheel underpan and remove the two lower transmission to clutch housing cap screws.
7. Remove the two top transmission to clutch housing cap screws, then slide the transmission on straight back until the clutch gear shaft is free of the splines in the clutch disc and lift it out through the cab door.

¾-Ton Truck

1. Remove the floor mat and floor board.
2. Remove the cap screws which attach the universal ball collar to the rear end of the transmission and slip the ball and collar back on the front propeller shaft housing.
3. Split the intermediate universal joint by removing the two trunnion bearing "U" clamps from the front yoke of the universal. Wrap a piece of tape endwise over the trunnion bearing to keep them in place and also prevent dirt from entering them.
4. Remove the bolts which attach the support bracket to the frame crossmember. Then pull the front propeller shaft assembly toward the rear to clear the splines of the front universal joint.
5. Remove the flywheel underpan and remove the two lower transmission to clutch housing cap screws.
6. Remove the two top transmission to clutch housing bolts, then slide the transmission straight back until the clutch gear shaft is free of the splines in the clutch disc and lift it out through the cab door.

DISASSEMBLY OF THE TRANSMISSION

The illustration, Fig. 2, shows an exploded view of the transmission. The reader should study this illustration and note the relative position of all parts before disassembling one of these units.

1. Mount the transmission in the transmission holding fixture, J-934, as shown in Figure 3.
2. Remove the four cap screws from the gear shift lever housing.

   CAUTION—These screws should be backed off evenly, or two of the screws should be removed and replaced with longer ones, in order to relieve the tension of the gear shift lever spring before removing the retainer.
3. Remove the retainer, lever, ball seat, spring and gasket.

   NOTE—Under ordinary circumstances it is not necessary to remove the shifter assembly from the cover.
4. Remove the four cap screws from the transmission cover and remove the cover and gasket. It will be noticed that the two front screws are special screws that also lock the shifter shafts in the transmission case.
5. Lift out the shifter interlock.
6. Drive the shifter shafts from the case with a soft steel drift, driving them from the rear of the case to the front. Both of these shafts are .003" larger in diameter where they fit into the front of the case. Both front and rear diameters are ground to close limits so that the shafts will fit snugly in the case.
7. Remove the shifter yokes, lock balls, and springs from the case.
8. Place the transmission in two gears at once to lock the mainshaft, and remove the universal

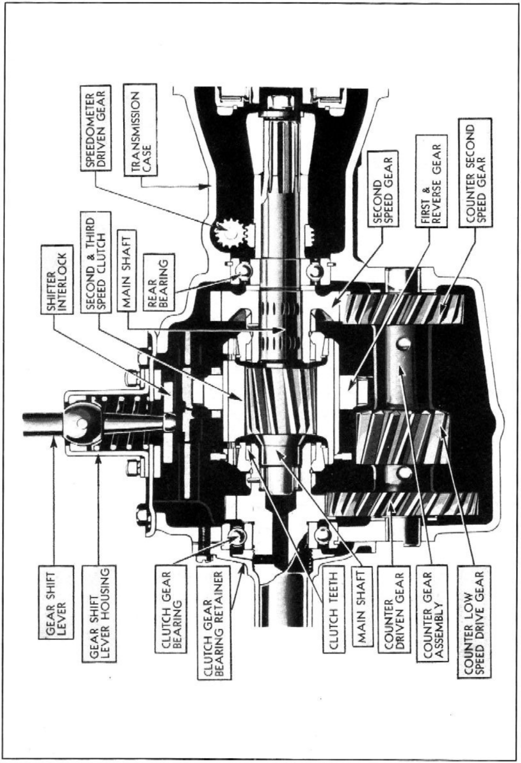

Fig. 1—½ and ¾-Ton Syncro-Mesh, Three-Speed Transmission

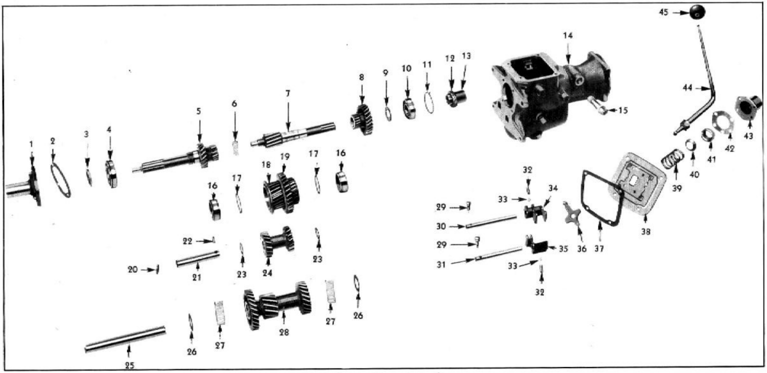

Fig. 2—Layout of Transmission Parts

1—Clutch Gear Bearing Retainer
2—Clutch Gear Bearing Retainer Gasket
3—Clutch Gear Bearing Nut and Oil Slinger
4—Clutch Gear Bearing
5—Clutch Gear
6—Mainshaft Pilot Bearing (14)
7—Mainshaft
8—Second Speed Gear
9—Second Speed Gear Thrust Washer
10—Mainshaft Rear Bearing
11—Mainshaft Rear Bearing Lock Ring
12—Speedometer Drive Gear
13—Universal Joint Spacer
14—Transmission Case
15—Speedometer Driven Gear
16—Synchronizing Ring
17—Synchronizing Ring Retainer
18—Synchronizing Drum
19—First and Reverse Sliding Gear
20—Expansion Plug
21—Reverse Idler Shaft
22—Reverse Idler Shaft Lock Pin
23—Reverse Idler Gear Thrust Washer
24—Reverse Idler Gear
25—Countershaft
26—Counter Gear Thrust Washer
27—Countershaft Bearing (25 each end)
28—Counter Gear
29—Shifter Shaft Lock and Front Cover Screw
30—First and Reverse Shifter Shaft
31—Second and Third Shifter Shaft
32—Detent Spring
33—Detent Ball
34—First and Reverse Shifter Yoke
35—Second and Third Shifter Yoke
36—Shifter Interlock
37—Transmission Cover Gasket
38—Transmission Cover
39—Gearshift Lever Spring
40—Gearshift Lever Spring Seat
41—Gearshift Lever Fulcrum Ball Retainer
42—Gearshift Lever Ball Housing Gasket
43—Gearshift Lever Ball Housing
44—Gearshift Lever
45—Gearshift Lever Knob

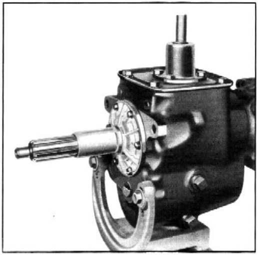

Fig. 3—Transmission in Holding Fixture

joint retaining cap screw, plain washer and lockwasher. Slide the universal joint off the mainshaft.

CAUTION—Care should be used when shifting the gears into second or third to prevent damage to the wedge angles.

9. Remove the six clutch gear bearing retainer screws and shakeproof lockwashers. Remove the retainer. Note that the screw holes in the retainer are unevenly spaced so that the retainer may only be assembled to the case in one position, matching up the oil return slot with the hole in the case.

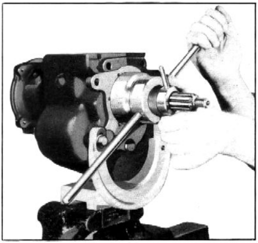

Fig. 4—Removing Clutch Gear and Bearing

10. Install the special clutch gear and bearing puller, J-937, by screwing the threaded sleeve (left-hand thread) onto the clutch gear shaft. Pull the clutch gear and bearing from the case by turning the puller handles, Figure 4.

    CAUTION—Do not DRIVE the clutch gear as damage to both the pilot on the mainshaft and the internal bearing surface in the clutch gear will result.

11. Remove the 14 roller bearings from inside the clutch gear.
12. Turn the yoke of the mainshaft removing and replacing tool, J-938, back on the threads and screw the puller shaft into the threaded end of the mainshaft. Bolt the yoke of the tool to the rear face of the transmission case.

    IMPORTANT—Turn the front synchronizer ring so that the lugs line up with the slots in the mainshaft helical spline.

13. While holding puller shaft handle, turn the puller handles clockwise to force the mainshaft out of the rear bearing, Fig. 5. Disassemble the puller from the mainshaft and the transmission case, and remove the mainshaft from the transmission through the front of the case.

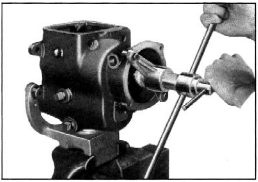

Fig. 5—Removing Mainshaft

14. Shift the second speed gear into the clutch sleeve. Remove the clutch sleeve assembly, first and reverse sliding gear, and the second speed gear from the case as a unit. Remove the second speed gear thrustwasher from the case.
15. Expand the rear bearing lock ring into the case with the special expanding tool, J-935. This raises the lock ring from the groove in the bearing and the bearing may be removed by lightly tapping the outer race toward the inside of the case, Fig. 6.

    It is necessary to remove the rear bearing before attempting to remove the countergear.
16. Remove the countershaft by driving it from the rear to the front of the case, using a soft steel drift. Remove the countergear and the front and rear countergear thrustwashers as well as any roller bearings that may have dropped to the bottom of the case.
17. Drive out the reverse idler shaft expansion plug from the inside of the case. A hook-nosed punch or drift will be found most suitable for this job.

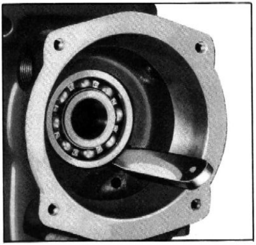

Fig. 6—Removing Rear Bearing

18. Drive the idler shaft lock pin into the shaft. This pin is shorter in length than the diameter of the shaft, so that the shaft may be slipped out when the pin is driven in. DO NOT turn the shaft while removing as the lock pin may drop down between the idler shaft bushings.

    NOTE—It is necessary to remove the countergear before removing the idler shaft, otherwise the idler shaft will strike the countergear.

19. Remove reverse idler shaft and thrust washers.

Disassembly of the Clutch Gear

1. Place the clutch gear in a vise and remove the bearing retaining nut and oil slinger, using special wrench J-933, Fig. 7. The retaining nut and oil slinger is a one-piece steel casting machined with a left-hand thread and is locked in place on the clutch gear shaft by being staked into a hole provided for that purpose.

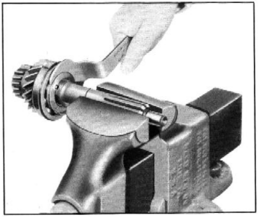

Fig. 7—Retaining Nut and Oil Slinger Removing Tool

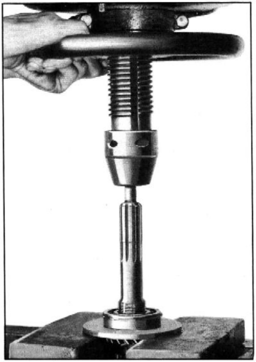

Fig. 8—Removing Clutch Gear Bearing

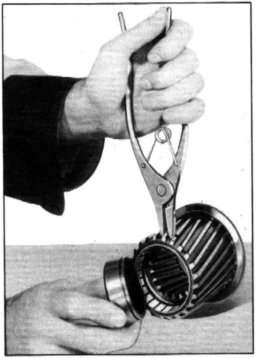

Fig. 9—Removing Synchronizing Ring from Second and Third-Speed Clutch

2. To remove the clutch gear bearing, place the special press plate, J-936, over the gear and against the bearing. Using an arbor press, press the shaft out of the bearing, Fig. 8.

CAUTION—Do not attempt to DRIVE the shaft out of the bearing or the bearing will be seriously damaged.

Disassembly of the Clutch Sleeve

1. Remove the second speed gear.
2. Remove the first and reverse sliding gear.
3. Turn the synchronizing ring in the clutch sleeve until the ends of the synchronizing ring retainers can be seen through the slot in the clutch sleeve.
4. Using special pliers, J-932, expand the retainer into the counterbore in the clutch sleeve. This raises the retainer from the groove in the ring, and the ring may easily be slipped out, Fig. 9.

INSPECTION

Wash all parts of the disassembled transmission in cleaning solvent.

Cleaning and Inspection of Bearings

1. Wash the bearings thoroughly in cleaning solvent.
2. Blow out the bearings with compressed air.

   CAUTION—Do not allow the bearings to spin, but turn them slowly by hand. Spinning bearings will damage the races and balls.
3. After making sure the bearings are *clean*, lubricate with light engine oil and check them for wear or roughness. Roughness may be determined by slowly turning the outer race by hand.

Transmission Case

Wash out the transmission case and inspect for cracks. Inspect the front face which fits against clutch housing for burrs and if any are present, dress them off with a fine cut mill file.

Gears

1. Inspect all gears and, if necessary, replace any that are worn or damaged.
2. Check the first and reverse sliding gear to make sure it slides freely on the clutch sleeve.
3. Check the clutch sleeve to see that it slides freely on the mainshaft.
4. Check the synchronizing cones for wear or for being loose in the clutch sleeve. If the cones are damaged in any way, it will be necessary to replace the clutch sleeve assembly and both synchronizing rings.

Synchronizer Rings

1. Inspect the synchronizer rings for smoothness.
2. Place the synchronizer rings in the synchronizing cones and check with the thumbs to see that the rings do not rock. Excessive rocking indicates a poor fit between the ring and cone, which will not permit proper synchronizing of the gears during shifting.

Energizing Springs

1. It will be noticed upon examining the spring that one of the ends is slightly offset. The spring is assembled in its groove with this offset between the fourth and fifth clutch teeth of either bank of teeth, thus keeping the spring from turning in its groove.
2. Under normal operation it should never be necessary to replace the energizing springs; however, should an energizing spring be removed for any reason, a new spring should be installed. The spring may be removed by slipping a thin blade under the spring and raising it over the clutch teeth on the gear and slipping it off over the teeth.

   CAUTION — In replacing the energizing spring, be very careful not to distort the spring when expanding it over the clutch teeth.

Countergear

Inspect the countergear rollers and the bearing surfaces inside the countergear and on the countershaft carefully for scoring or other damage. Replace any parts found damaged.

REASSEMBLY

Reverse Idler

1. Lubricate the reverse idler gear thrustwashers and install the gear and thrustwashers in the case with the gear having the chamfered teeth to the rear of the case.
2. Install the idler shaft, making sure that the lock pin hole in the shaft lines up with the hole in the case at the same angle. (See Fig. 10.)

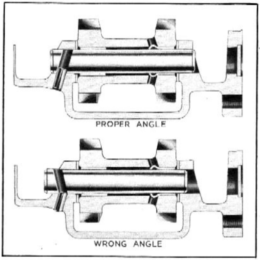

Fig. 10—Reverse Idler Gear, Shaft and Lock Pin

CAUTION—A pin punch should be used to make sure that these holes line up, for if the

lock pin is driven into the case and shaft with the hole in the shaft at the wrong angle serious damage will result.

3. Use a new idler shaft lock pin and drive it in approximately 1/16" beyond flush with the case, and peen the hole slightly. This lock pin must be a tight fit in the case to prevent oil leaks.
4. Install the idler shaft expansion plug in the case.

Countergear

1. Coat the roller bearing area in each end of the gear with cup grease. Insert countershaft in the gear, and place gear and shaft on the bench with the large diameter end of the shaft down. Insert twenty-five rollers in this end of the gear, then reverse the position of the counter gear on the bench and insert twenty-five rollers at the opposite end as shown in Fig. 11. Remove countershaft (note that the rollers remain in place and flush with the ends of the gear).

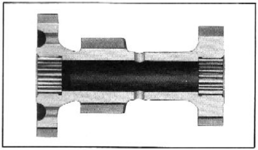

Fig. 11—Countergear Roller Bearings

2. Install counter gear in transmission case. Lubricate the front thrust washer and assemble it between the gear and the case; then, sighting through the front hole in the case, roughly align the thrust washer and gear.
3. Push the assembly tool (taper end first) into the front countershaft hole in case. The taper on the assembly tool will align the thrust washer and counter gear for easy assembly of the shaft.
4. Push the countershaft into the front hole in the case, pushing the assembly tool ahead of it until the taper on the tool just enters the rear roller bearing.
5. Lubricate the rear thrust washer and assemble it between the gear and the case. Sighting through the rear hole in the case, align the thrust washer, then continue to push the countershaft into the case. The assembly tool will now properly align the gear and thrust washer at the back end while it is being pushed out of the case ahead of the shaft. The flat on the forward end of the countershaft engages the clutch housing when the transmission is installed in the chassis, and keeps the countershaft from turning. This flat must be horizontal and at the top; otherwise the transmission cannot be assembled to the clutch housing.

NOTE—The step at the end of the countershaft should be driven in flush with the case, or approximately 1/64" below the face, to maintain proper transmission alignment.

Rear Bearing

1. Install the rear bearing lock ring in the case.
2. Start the bearing in from the rear, and use the lock ring expanding tool, J-935, to expand the ring into the case. Refer to Fig. 6.
3. Using a soft steel drift, tap the bearing on the outer race until it is in about halfway; then remove the lock ring expanding tool and continue to tap the bearing until the lock ring seats in the groove in the bearing.

Synchronizing Clutch Sleeve Assembly

1. Install the synchronizer ring retainers in the counterbores in the ends of the clutch sleeve.
2. With the special pliers, J-932, expand the retainer, at the same time holding it flush with the back face of the cone. Install the synchronizer rings making sure that the retainers seat in the groove all the way around the rings, Fig. 9.
3. Install the first and reverse sliding gear on the clutch sleeve.
4. Install the second speed gear in the rear end of the clutch sleeve, meshing the clutch teeth on the gear with the internal teeth in the clutch sleeve.
5. Coat the grooved side of the second speed gear thrustwasher with transmission lubricant and place the washer on the back face of the second-speed gear. Then install the clutch gear assembly in the transmission case.

Mainshaft

1. For initial lubrication, place transmission lubricant on the second-speed gear bearing area of the mainshaft. When installing the mainshaft, the lugs on the front synchronizer must slide through the slots in the mainshaft

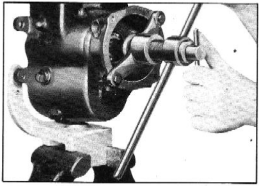

Fig. 12—Installing Mainshaft

spline. Push the shaft into the clutch sleeve as far as possible by hand, picking up the second speed gear and thrustwasher.

2. Turn the yoke of the mainshaft removing and replacing tool, J-938, down on the threads and screw the tool shaft into the threaded end of the mainshaft. Bolt the yoke of the tool to the rear face of the transmission case.
3. Turn the tool handles counterclockwise until the mainshaft is seated in the rear bearing, Fig. 12. The proper seating of the shoulder on the shaft against the inner race of the bearing may be determined by checking the end play of the second speed gear which should be approximately .010".

Clutch Gear

1. Using an arbor press, press the clutch gear bearing onto the clutch gear with the locating ring toward the front end of the gear shaft so that the bearing will enter the case to the maximum possible depth.
2. Install the combination clutch gear bearing retaining nut and oil slinger on the clutch gear shaft and draw it up tight, using the special wrench, J-933.
3. Lock the retaining nut and oil slinger in place by staking it into the hole with a center punch. Care must be used not to damage the thread on the shaft.

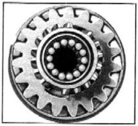

Fig. 13—Mainshaft Pilot Bearing Rollers in Clutch Gear

4. Place some cup grease in the mainshaft pilot hole in the clutch gear and install the 14 roller bearings, Fig. 13. After being assembled in the pilot hole, these bearings will lock themselves in place and cannot fall out. Install the clutch gear in the transmission case.
5. Using a soft steel drift, tap the clutch gear bearing on the outer race until the bearing locating ring seats against the case, being careful to drive the assembly straight to prevent damage to the mainshaft pilot and pilot bearing.

   CAUTION—During this operation make sure that the synchronizer ring lugs line up with the slots between the clutch teeth on the clutch gear.
6. Install the clutch gear bearing retainer, making sure that the oil slot in the retainer lines up with the oil slot in the front face of the transmission case. Do not allow the gasket to protrude beyond the edge of the retainer.
7. Install the retainer screws, using the special shakeproof lockwasher. Draw the screws up evenly.
8. Check the transmission in all gears to be sure that there is no indication of a bind in any position.

Universal Joint

1. Install the spacer and speedometer drive gear on the mainshaft and slide the front yoke of the universal joint on the main shaft.
2. Install the washer and cap screw. Tighten the cap screw securely.

Shifter Mechanism

1. Install the shifter yoke lock balls and springs in the side of the transmission case.
2. Install the shifter yokes in the sides of the case, placing the first and reverse yoke over the first and reverse sliding gear, and the second and high yoke over the ring on the clutch sleeve.
3. Install the shifter shafts from the front of the case, the longer of the two being the first and reverse shaft. Line up the lock holes in the shafts with the two front cover holes in the top of the case.
4. Lay the shifter interlock in slots in the shifter yokes, with the pins upward. The interlock shifter lies in the slots so that the hole is closer to the second and high speed shifter shaft.

   The illustration Fig. 14 shows the relationship of the various parts of the shifter mechanism.
5. Assemble the transmission cover and gasket to the case, using the two special cap screws at the front.
6. Place the gear shift lever housing over the shift lever; install the shift lever spring and ball seat in the retainer.

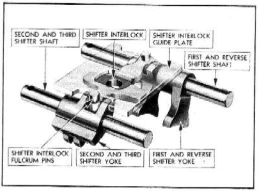

Fig. 14—Shifter Mechanism

7. Assemble the retainer and gasket to the transmission cover with the four cap screws, drawing the screw down evenly to prevent the shift lever spring from exerting a strain on the die cast retainer, or using two longer cap screws in opposite holes to aid in compressing the spring enough to start the short screws in place; then remove the two long screws and replace them with the other two regular screws.
8. Check the operation of the transmission by shifting into all gears.
9. Install the transmission in the truck.

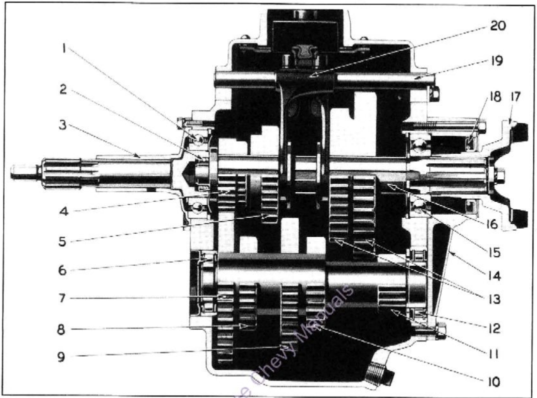

Fig. 15—Four-Speed Transmission Construction

1—Clutch Gear Bearing
2—Mainshaft Pilot Bearing
3—Clutch Gear Bearing Retainer
4—Clutch Gear
5—High Speed Sliding Gear
6—Countershaft Front Bearing
7—Countershaft Drive Gear
8—Countershaft Reverse Gear
9—Countershaft Third Speed Gear
10—Countershaft Second Speed Gear
11—Countershaft Low Speed Gear
12—Countershaft Rear Bearing
13—Low, Second and Reverse Speed Sliding Gear
14—Rear Bearing Retainer
15—Mainshaft Rear Bearing
16—Mainshaft
17—Universal Joint Flange
18—Oil Seal
19—Gear Shifter Shaft
20—Shifter Forks

FOUR-SPEED TRANSMISSION

Construction

The four-speed transmission is a heavy-duty transmission of sturdy construction and is designed to give efficient service in every type of truck operation.

The case is made of cast iron, accurately machined to give the proper alignment of the gears and their shafts. All of the gears are machined from drop forged steel gear blanks, and are heat treated for strength and long life. The shafts are machined from high grade steel, and are heat treated and ground to close limits.

The main drive gear is supported by a heavy-duty New Departure ball bearing. The forward end of the spline shaft is supported by a Hyatt roller bearing, while the rear end receives its bearing from a New Departure ball bearing. Both ends of the countershaft run in heavy-duty Hyatt roller bearings.

Fig. 15 shows the sturdy construction of this transmission and the relative positions of all of the parts.

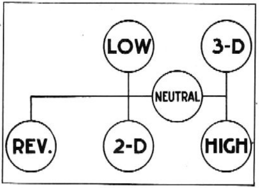

Fig. 16—Gearshift Lever Positions

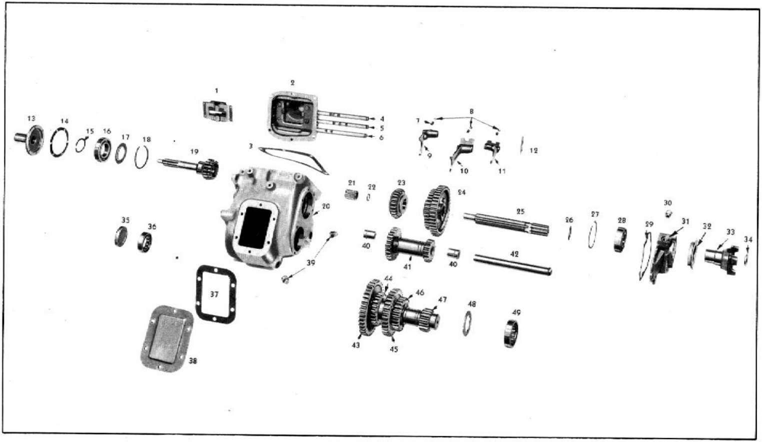

Fig. 17—Layout of Four-Speed Transmission Parts

1—Shifter and Guide Plate
2—Case Cover
3—Cover Gasket
4—3rd and 4th Shifter Shaft
5—1st and 2nd Shifter Shaft
6—Reverse Shifter Shaft
7—Yoke Lock Ball Spring
8—Yoke Lock Ball
9—Forward Shifter Yoke
10—Reverse Shifter Yoke
11—Forward Shifter Yoke
12—Shifter Shaft Retainer
13—Bearing Retainer
14—Bearing Retainer Gasket
15—Bearing Lock
16—Clutch Gear Bearing
17—Oil Slinger
18—Bearing Lock
19—Clutch Gear
20—Case
21—Main Drive Shaft Pilot Bearing
22—Thrust Ring
23—3rd and 4th Speed Gear
24—1st and 2nd Speed Gear
25—Main Drive Shaft
26—Bearing Inner Spacer
27—Bearing Lock
28—Rear Mainshaft Bearing
29—Bearing Retainer Gasket
30—Speedometer Driven Gear Fitting
31—Rear Mainshaft Bearing Retainer
32—Oil Seal
33—Universal Joint Flange
34—Universal Joint Washer
35—Bearing Spacer
36—Countershaft Front Bearing
37—Power Take-Off Cover Gasket
38—Power Take-Off Cover
39—Plug
40—Reverse Idler Gear Bushing
41—Reverse Idler Gear
42—Reverse Idler Shaft
43—Driven Counter Gear
44—Reverse Counter Gear
45—3rd Speed Counter Gear
46—2nd Speed Counter Gear
47—Counter Shaft
48—Thrust Washer
49—Countershaft Rear Bearing

OPERATION

Due to the simplicity of construction of the four-speed transmission, there is no need to go into a lengthy discussion on its operation.

The gearshift lever positions for the various gears are clearly shown in Fig. 16.

REPAIR OPERATIONS

Removal from Chassis

To remove the transmission from the truck proceed as follows:

1. Remove the floor boards and disconnect the speedometer cable from the rear bearing retainer. Remove the hand brake lever from the transmission case.
2. Drain the lubricant from the transmission and remove the front propeller shaft assembly as explained under the Rear Axle Section of this Manual.
3. Remove the two top cap screws holding the transmission to the clutch housing and insert the two transmission guide pins in these holes.
4. Remove the flywheel underpan and remove the two lower transmission-to-clutch-housing cap screws.
5. Slide the transmission straight back on the guide pins until the clutch gear is free of the splines in the clutch disc. The guide pins support the transmission during this operation and prevent damage to the clutch disc.
6. Remove the transmission and place it in the transmission bench stand.

The illustration, Fig. 17, shows an exploded view of the transmission. Each part is given a key number and the legend gives the name of the part. The reader should study this illustration and the relative position of all parts before disassembling one of these units.

Disassembling the Transmission

1. Mount transmission in holding fixture.
2. To remove the gearshift lever, slide the open side of K-353 gearshift lever remover, shown in Fig. 18, over the lever, engage the lugs in the tool in the open slot of the retainer. Then press down on the tool and turn it to the left to disengage the lugs on the retainer. Lift the lever out of the cover.
3. Remove the transmission cover assembly and place the transmission in two gears at once to lock the mainshaft.
4. Remove the cap screw and washer which retain the universal joint front yoke to the mainshaft.
5. Remove the seven cap screws which attach the rear bearing retainer to the case.
6. Remove the clutch gear bearing retainer and drive out the clutch gear and bearing, using a soft steel drift to avoid damaging the teeth of the gear.
7. Remove the spline shaft pilot bearing and drive out the spline shaft and bearing through the rear end of the case. Remove the sliding gears.
8. Drive out the reverse idler gear shaft from the *front* to the *rear* and remove the reverse idler gear.
9. Drive the countergear to the rear to remove the rear bearing. Remove the countergear and drive out the countershaft front bearing and retainer by tapping lightly around the outer race of the bearing.
10. The bearings can be removed from the spline shaft and from the clutch gear by supporting the inner race of each bearing on an arbor press and pressing on the end of the shaft until it is free of the bearing.

Fig. 18—Removing Gearshift Lever—Conventional Model

Inspection

After the transmission has been completely disassembled, all parts should be thoroughly washed in cleaning solvent and inspected for wear or damage.

All bearings should be thoroughly cleaned, oiled with light engine oil, and checked for scored races or worn balls or rollers. To check the bearings for excessive looseness or for roughness, hold the inner race in one hand and turn the outer race slowly in the other hand. DO NOT spin bearing with compressed air.

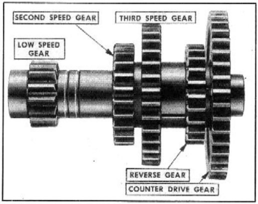

Fig. 19—Transmission Countershaft

Countershaft and Idler Gears

Should it be necessary to replace the gears on the countershaft, the old gears should be pressed off on an arbor press and the new gears pressed on the shaft. When reassembling the gears to the countershaft, care must be used to place the gears in correct position on the shaft and also to install the three spacers in their proper place between the gears. The chamfered side of the second speed gear faces the low speed gear. The chamfered side of the third speed gear faces the chamfered side of the reverse gear. The illustration, Fig. 19, shows the order in which the gears are pressed on the shaft.

The ¼ inch wide spacer goes between the second and third speed gears. The ⅞ inch wide spacer is assembled between the third speed and reverse gears, and the 5/32 inch wide spacer between the reverse and countershaft drive gears.

When pressing the gears on the countershaft, the round keys should be used to keep the keyways lined up. After the gears are pressed into place, the round keys should be driven down 1/32 inch below flush with the gear. Any burrs set up should be filed down smooth.

If the bushings in the idler gear show signs of wear, they should be removed from this gear, with the special tool, J-1662. This same tool may be used to replace these bushings in the gear. After the new bushings have been installed, they should be reamed to size, using KMO-349 reamer, Fig. 20, leaving a minimum clearance of .002" between the bushings and shaft for proper lubrication.

Oil Seal

A spring-loaded leather oil seal is pressed into the rear bearing retainer and the leather bears on the ground hub of the universal joint front yoke.

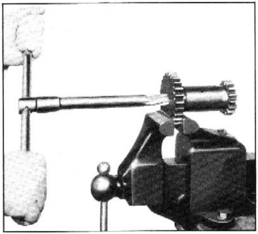

Fig. 20—Reaming Idler Gear Bushings

To replace an oil seal, the rear bearing retainer must be removed from the transmission. Then press the oil seal from the rear retainer.

Before installing a new oil seal, it should be thoroughly soaked in engine oil. When pressing the new seal into the bearing retainer, care should be used to line up the bolt holes in the seal with the bolt holes in the retainer.

Reassembling the Transmission

1. Assemble the countergear front bearing and retainer to the case. The open side of the retainer should be toward the outside and its edge flush with the case. Place the countergear and shaft in the transmission and assemble the thrust washer and rear bearing as shown in Fig. 21.

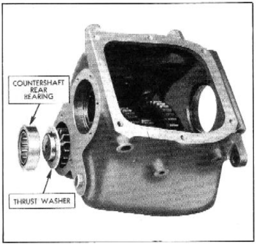

Fig. 21—Method of Assembling Countershaft

2. For the purpose of checking the end play between the countergear and the case without further assembly of the transmission, assemble the rear bearing retainer and gasket to the rear face of the case. Check the end play between the thrust washer and the shoulder on the counter gear. This end play should be from .015" to .045". If it exceeds .045" shim between the front countershaft bearing and its retainer until the end play is within the above limits.
3. Place the idler gear in the transmission case and drive the idler gear shaft into position from the *rear* to the *front*, being careful to have the flat machined surface on the end of the shaft in a vertical position, and toward the countershaft.
4. Assemble the clutch gear and bearing and bearing retainer to the case, using a new gasket. Install the lock plates and cap screws, then bend up the edges of the lock plates against the hex head of the cap screws. Dip the main spline shaft pilot bearing in transmission lubricant and assemble it in the inside of the clutch gear.
5. Place the sliding gears in the transmission, with the shifter fork grooves toward each other, and assemble the spline shaft and bearing through these gears and into the case.
6. Assemble the rear bearing retainer and gasket to the case and tighten the seven cap screws securely.

7. Install the universal joint front yoke on the main shaft. Place the transmission in two gears at once to lock the mainshaft. Install the special flat washer (with the indentations toward the yoke) and lockwasher under the head of the cap screw which anchors the universal joint front yoke to the mainshaft. Then tighten the screw securely.

Transmission Cover Assembly

1. To disassemble the transmission cover, remove the two screws which attach the shifter shafts lock plate and remove the plate.
2. When removing the three shifter shafts from the cover, turn the shafts one-half turn to raise the shift lock balls out of the notches in the shafts, then push the shafts out of the cover and shifter forks, being careful not to lose the lock balls and springs which are located in the shifter forks.
   Should it become necessary to replace the shifter interlock plate, cut the heads from the four rivets and remove the plate. A new plate may be installed by riveting it to the cover.

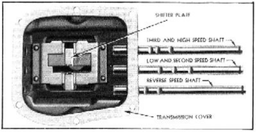

Fig. 22—Shifter Shaft Assembly

Reassembly

1. In reassembling the transmission cover, care must be used in installing the shifter shafts. They should be installed in the order shown in Fig. 22, namely reverse speed, low speed and high speed.

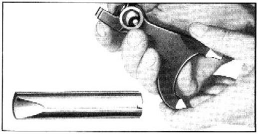

Fig. 23—Depressing Lock Ball

2. In assembling the shifter forks to the shafts, first place the shift lock spring and ball in the fork. With the special tool shown in Fig. 23 force the ball down on the spring in the fork, then turn the tool one-half turn to hold the ball in position. This tool holds the shift lock ball and prevents it from jumping out while the shaft is being installed.
3. Install the shifter shaft lock plate. Install the cover and gasket to the transmission case being sure that the shifter forks enter the shifter fork grooves in the gears. Install the gearshift lever using K-353 gearshift lever remover and replacer.

Replace the transmission in the truck.

TRANSMISSION TROUBLES AND REMEDIES

Symptom	Probable Remedy
Slips Out of High Gear	
1. Transmission loose on clutch housing.	1. Tighten transmission on clutch housing.
2. Shift lock spring weak or broken.	2. Replace shift lock spring.
3. Bent shifter fork.	3. Replace shifter fork.
4. Damaged mainshaft pilot bearing.	4. Replace main shaft pilot bearing. (Check bore in clutch gear and pilot end of mainshaft for wear or damage.)
Slips Out of Low Gear	
1. Shift lock spring weak or broken.	1. Replace shift lock spring.
2. Bent shifter fork.	2. Replace shifter fork.
3. Worn low speed gears.	3. Replace low speed sliding gear and low speed countershaft gear.
Noisy in Reverse	
1. Worn reverse idler gear bushings.	1. Replace idler gear bushings.
Difficulty in Shifting into Low Gear	
1. Worn reverse latch on lower end of gearshift lever.	1. Replace reverse latch.
2. Worn gearshift interlock guide plate.	2. Replace gearshift interlock guide plate.
Lubricant Leaks into Clutch Housing	
1. Transmission case overfilled with lubricant.	1. Lower lubricant to proper level. (See Lubrication Section.)
2. Clutch gear bearing retainer loose.	2. Remove transmission, replace gasket and tighten clutch gear bearing retainer.

TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling the transmission:

Tool Number	Description
J-934........	Transmission Holding Fixture
J-937........	Clutch Gear and Bearing Puller
J-938........	Main Shaft Removing and Replacing Tool
J-935........	Rear Bearing Lock Ring Expanding Tool
J-933........	Retaining Nut and Oil Slinger Removing Tool
J-936........	Clutch Gear Bearing Thrust Plate
J-932........	Synchronizing Ring Retainer Pliers
K-386.......	Countergear Assembly Tool
T-1617.......	Countergear Assembly Tool
K-353.......	Gearshift Lever Removing Tool
J-1662.......	Idler Gear Bushing Remover and Replacer 1½ Ton, 4-Speed
KMO-34-C...	Idler Gear Bushing Reamer 1½ Ton, 4-Speed

TRANSMISSION SPECIFICATIONS

Type	Selective Synchro-Mesh	Selective Sliding Gear
Speeds	3 Forward, 1 Reverse	4 Forward, 1 Reverse
Mounting	Unit Powerplant	Unit Powerplant
BEARINGS		
Clutch Shaft—In Crankshaft	Needle	Needle
Type	Hyatt 99004	Hyatt 99004
Clutch Shaft—Rear	Ball	Ball
Type	New Departure ND-43027-C	New Departure ND-3209
Mainshaft—Front	Roller	Needle
Type	14 Chev. No. 590752	Hyatt 93424
Mainshaft—Rear	Ball	Ball
Type	New Departure ND-43305-C	New Departure ND-3307
Countergear—Front	Roller	Roller
Type	25—Chev. No. 591211	Hyatt C-1206
Countergear—Rear	Roller	Roller
Type	25—Chev. No. 591211	Hyatt C-1207
Reverse Gear	Bronze Bushing	Bronze Bushing
GEAR RATIOS		
First Speed	2.94 to 1	7.06 to 1
Second Speed	1.68 to 1	3.48 to 1
Third Speed	Direct	1.71 to 1
Fourth Speed	None	Direct
Reverse Speed	2.94 to 1	6.98 to 1

Section 8

FUEL TANK AND EXHAUST SYSTEM

FUEL TANK

½-Ton Truck (Except Cab Type)

The fuel tank of the ½-ton panel and chassis type truck is located on the right side of the chassis, just inside the frame side rail and between the second and third crossmembers. A strong mounting of two straps supports it underneath the floor, the front strap being attached to the steel floor at the front of the body and the rear one to a flanged channel which is used to reinforce the floor boards at this point, at the same time making possible a durable support for the rear strap.

The steel floor at the front strap has a large stiffening rib stamped crosswise in it, thus providing a support for the front of the tank similar to the cross brace at the rear. Metal-to-metal contact is prevented by anti-squeak material. The tank is also set far enough from the side rail to prevent any rubbing. A covered opening is provided in the floor for access to the tank gauge unit.

This tank is of heavy, leak-proof construction and has a capacity of sixteen gallons. It consists of two similar pans, welded together and reinforced with stiffening ribs around the sides. The filler neck extends through the body panel and is designed to permit rapid filling of the tank. A special vent tube extends the entire length of the filler neck into the top of the tank. A large baffle near the neck prevents surging. This fuel tank and its mounting is shown in Fig. 1.

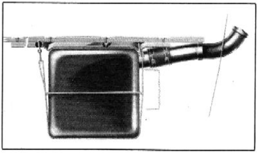

Fig. 1—½-Ton Truck Fuel Tank (Except Cab Type)

¾-Ton Trucks (Except Cab Type)

The 18 gallon fuel tank used on the ¾-ton truck is located in the same relative position to the frame as on the ½-ton truck. The mounting is similar to the ½-ton truck except that instead of being attached to the load platform the tank is anchored to the frame side rail by two brackets and two straps. The brackets are bolted to the frame side rail and the straps, which go around the tank, are in turn fastened to the brackets.

The tank construction is also similar to the ½-ton truck except for the increased capacity of 18 gallons.

½, ¾ and 1½-Ton Cab Type Trucks

An eighteen gallon fuel tank is used on all cab trucks and the 1½ ton single unit body trucks. The tank is mounted directly on top of the frame under the driver's seat. A riser formed across the top half of one end of the tank prevents air from being trapped by fuel entering the tank from the filler neck.

On all cab type trucks the filler neck emerges from the end of the riser while on the 1½-ton single unit body trucks, the filler neck projects from the side of the riser. In both cases, the filler neck extends outside the body. Where it goes through the body panel, a moulded rubber grommet seals the clearance hole and prevents spilled gasoline from entering the cab or body.

With the filler neck attached to the riser, which is the highest point of the fuel tank, rapid filling of the fuel tank is possible without the possibility of fuel being blown out again by trapped air.

FUEL TANK FILLER CAP

To prevent spilling of gasoline when making sharp turns or traveling on rough roads, a device, consisting of a baffle cup and a vent pin is incorporated in the filler cap. Through this arrangement the vent area is reduced to a minimum, yet is large enough to serve as a breather for the fuel tank. The small vent area is accomplished by inserting a special pin in the breather holes which are kept open by the bouncing or "jiggling" action of the pin. This minute area, if pierced in the outer part of the cap as a separate hole, would soon be clogged by dirt or corrosion.

The device not only controls the flow of gasoline, but also traps in the baffle cup any that might escape through the lower vent. The chamber volume is adequate for the ordinary overflow, which subsequently returns to the tank. A small hole is provided at the top of the chamber to complete the breather system.

GASOLINE TANK CAPACITIES

½-Ton Truck (Except Cab Types).....16 Gallons
½-Ton Cab Type, ¾ and
1½-Ton Trucks ....18 Gallons

EXHAUST SYSTEM

The muffler is of integral construction employing the reverse flow and diffusion principles to obtain quiet operation. The gas flow from the engine reaches the muffler through the inlet tube, reverses at the rear end and flows back toward the front.

Gases again flow back, this time through a tube leading to the outlet. The flow, however, is not restricted to the tubes, since the gases pour out through perforations in the tubes, mixing with the gases from the adjoining tube. The resulting mixing and baffling, with velocity changes and reversals in direction of flow, aids in silencing.

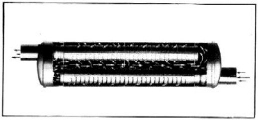

Fig. 2—Truck Muffler

The exhaust pipe from the manifold slides into the muffler inlet tube and is held in place by a clamp. Small projections on the exhaust pipe locate the proper depth in the muffler. A bracket extending from the frame, with its underside conforming to the curvature of the muffler, supports the muffler by a detachable strap at the center section of the muffler body. The tail pipe slides over the muffler outlet tube where it is held by a clamp. The outer end of the tail pipe is supported by a strap and bolt attached to the frame.

When assembling a new muffler and exhaust pipe assembly, all clamp bolts should be left loose until the parts are in correct relation to each other. Slight rotation of the muffler may be necessary to line up the inlet and outlet tubes properly. After correct position is obtained tighten the front muffler exhaust pipe clamp securely before tightening the muffler strap.

Section 9

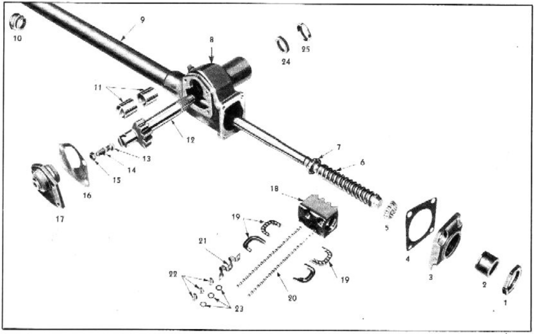

Fig. 1—Layout of Steering Gear Parts

1—Worm Bearing Adjuster Lock Nut
2—Worm Bearing Adjuster
3—Housing End Cover
4—End Cover Gasket
5—Hyatt Roller Bearing Assembly (Lower)
6—Steering Shaft Assembly
7—Hyatt Roller Bearing Assembly (Upper)
8—Housing
9—Column Jacket
10—Upper Steering Shaft Bearing Assembly
11—Pitman Shaft Bushing
12—Pitman Shaft Gear
13—Lash Adjuster
14—Lash Adjuster Shim
15—Check Nut 7/16 — 20
16—Housing Side Cover Gasket
17—Housing Side Cover and Bushing Assembly
18—Ball Nut
19—Ball Retainer Guide
20—Ball
21—Ball Return Guide Clamp
22—Bolt ¼—20
23—Lockwasher ¼ (Internal)
24—Pitman Shaft Packing
25—Pitman Shaft Packing Retainer

STEERING GEAR

The steering gear used in this truck is of the re-circulating ball type, having a reduction ratio of 19.8 to 1. Fig. 1 shows an exploded view of the steering gear parts.

The principal working parts of the gear are the steering worm, the ball nut and the pitman shaft and sector. Each one of these parts is of heat-treated alloy steel.

The worm is integrally welded to the steering main shaft and is mounted between two barrel roller bearings, the lower one of which is adjustable toward the upper, for taking out end play in the worm shaft. Between the roller bearings, the worm is threaded with a precision-finished helical groove.

The ball nut is bored to clear the outside diameter of the worm, and the bore is threaded with a precision-finished helical groove corresponding to that in the worm.

Within the length of the nut, the helical grooves are filled with steel balls conforming to specifications specially drawn up for this gear. There are two ball circuits in the nut. To keep the balls from running out of the ends, the nut is fitted with two tubular ball guides each of which deflects the balls from their helical path, and guides them diagonally across the back of the nut and returns them to the helical path in the nut. The two guides, together with the helical grooves in the worm and in the nut, thus confine the balls within two distinct closed circuits, one in each end of the nut.

The balls within the helical path constitute a thread between the worm and nut, so that when the worm is turned, the nut moves along the worm, as with an ordinary screw thread. At the same time the balls roll freely between the worm and nut, circulating within their closed circuits, so that screw motion is obtained with rolling instead of sliding contact between the parts.

Rugged rack teeth are cut in that portion of the nut which faces the pitman shaft sector. The pitman shaft is mounted in anti-friction bronze bushings. A grease seal is provided near the outer end of the pit-

man shaft gear. The sector portion of the pitman shaft is provided with rugged teeth which mesh with the rack teeth of the nut. The adjustment for backlash between the rack and sector is very simple; all that is required is to shift the pitman shaft slightly along its own axis by means of a convenient thrust screw, known as a lash adjuster.

The gear teeth are purposely cut in such a way that, when the gear is adjusted to take out all backlash at the center of travel, there will be a slight backlash at each end of travel. Thus, snugness of the gear in the straight-ahead position can be obtained without sacrifice of perfect freedom at extreme positions of the front wheels.

Adjustment

Correct adjustment of steering gear is very important. While there are but two adjustments to be made, the following procedure MUST be followed step by step and in the order given:

1. Disconnect the steering connecting rod from the pitman arm, taking care to note relative positions of steering connecting rod parts before disturbing them.

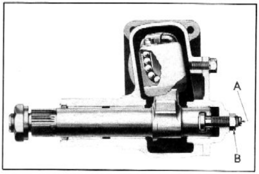

Fig. 2—Lash Adjustment

2. Loosen the mast jacket to instrument panel bracket, making sure there is no bind due to the anchorage.
3. Loosen the lock nut "B" (Fig. 2) and turn the lash adjuster "A" a few turns in a counter-clockwise direction. This removes from worm bearings the load imposed by close meshing of rack and sector teeth. Turn steering wheel gently in one direction until stopped by gear, then back away about one turn.

   CAUTION—Do not turn steering wheel hard against stops when steering connecting rod is disconnected, as damage to ball guides may result.

4. Using J-544A Steering Gear Checking Scale, measure the pull at the rim of the wheel which is required to keep the wheel in motion (Fig. 3). This should be between 1 and 1½ pounds.

   NOTE—When making this check, it is important that the line of the scale be kept tangent to the rim of the wheel.

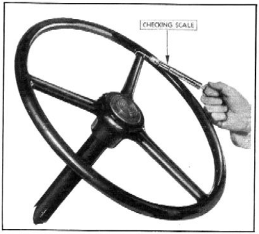

Fig. 3—Checking Worm Bearing Adjustment

If the pull necessary to move the wheel does not lie between the limits given above, adjustment of worm bearings is necessary.

5. To adjust the worm bearings, loosen lock nut "C" (Fig. 4) and turn worm bearing thrust screw "D" until there is no perceptible end play in worm. Check pull at wheel rim as outlined above, readjusting, if necessary, to obtain proper pull. Tighten lock nut "C" and recheck pull, as it must lie between the limits specified after the lock nut is tightened.

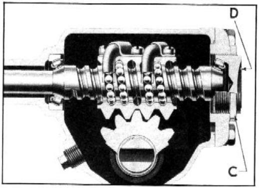

Fig. 4—Worm Gear Adjustment

If the gear feels "lumpy" after adjustment of worm bearings, there is probably damage in the bearings due to severe impact or to improper adjustment, and the assembly must be torn down for replacement of damaged parts. Instructions for disassembly follow under the heading "Repair Operations."

6. Make sure that it will not be necessary to spring the steering column in order to attach it to the instrument panel. It may be necessary to loosen the steering gear mounting bolts at the frame side rail and shift the gear slightly. Tighten mounting bolt nuts on the mast jacket clamp.

Then recheck the pull at the wheel rim. If this has increased materially, there is still a sprung condition in the column, which must be corrected before proceeding with the adjustment.

7. After proper adjustment of worm is obtained, and all mounting bolts securely tightened, adjust lash adjuster "A" (Fig. 2). First turn the steering wheel gently from one stop all the way to the other, carefully counting the total number of turns. Then turn wheel back exactly half way, to center position. Mark wheel at top or bottom center with a piece of tape. Turn lash adjuster "A" (Fig. 2) clockwise to take out all lash in gear teeth, and tighten lock nut "B." Check pull at wheel rim with checking scale as before, taking the highest reading of the checking scale as the wheel is turned through center position. This should be between 2 and 2½ pounds. Readjust, if necessary, to obtain proper pull. Tighten lock nut "B" and recheck pull, as it must lie between the specified limits after the lock nut is tightened.
8. Reassemble steering connecting rod to pitman arm.

REPAIR OPERATIONS

Steering Gear Removal

Repair operations on the steering gear require that it be removed from the chassis. To remove the steering gear from the chassis, proceed as follows:

1. Remove the floor and toe boards.
2. Remove the clevis pin from the brake lever pull rod at the idler lever.
3. Remove the steering wheel, using the steering wheel puller, J-1618. Remove mast jacket to instrument panel bracket and disconnect the horn wire.
4. Remove the steering connecting rod and pitman arm, using puller, J-1025, for the pitman arm.
5. Remove the housing mounting bolts.
6. Remove the two rear bolts and one side bolt which attach the left engine side pan.

The steering gear assembly can now be pulled up over the pedals and out the left door.

REPAIR OPERATIONS

Disassembly

DISASSEMBLY OF THE STEERING GEAR SHOULD NOT BE ATTEMPTED IN DIRTY SURROUNDINGS. AS WITH ANY OTHER MECHANISM CONTAINING BALL AND ROLLER BEARINGS, IT IS OF GREATEST IMPORTANCE TO KEEP THE PARTS ABSOLUTELY FREE FROM CONTACT WITH ANY DIRT OR FOREIGN MATTER DURING REMOVAL OF PARTS, WHILE DISASSEMBLED AND DURING REASSEMBLY. CLEAN NEWSPAPERS OR CLEAN RAGS SHOULD BE SPREAD OUT ON THE WORKBENCH TO RECEIVE THE PARTS AS THEY ARE REMOVED FROM THE GEAR.

1. Loosen lock nut "B" (Fig. 2) and turn lash adjuster "A" a few turns in counterclockwise direction. Next loosen lock nut "C" (Fig. 4) and turn worm bearing thrust screw "D" a few turns in a counterclockwise direction.
2. Place a receptacle under gear to catch the lubricant. Remove bolts and lockwashers which attach the side cover to housing. Pull side cover and with it pitman shaft from housing. If pitman shaft sector does not leave housing easily, turn steering shaft back and forth with the fingers to line up sector with opening in housing.
3. Remove bolts and lockwashers which attach the end cover to the bushing. Remove end cover and, with it, the lower roller bearing.
4. Grasp lower end of worm and draw steering shaft, worm and nut assembly out of the housing.

   CAUTION—Be sure that nut is not allowed to rotate on worm until it reaches end of thread during this operation. Damage to ends of ball guides is almost certain to result if this precaution is not taken. Lay the assembly in a horizontal position on the bench while it is out of the housing so that the nut cannot rotate on worm.
5. Remove lock nut from lash adjuster and unscrew lash adjuster from side cover. Slide the lash adjuster out of slot in end of pitman shaft, refer to cross section (Fig. 2).

Disassembly of Ball Nut

As a rule, disassembly of the ball nut will not be necessary, if it is perfectly free while rotating the ball nut on the worm. However, if there is evidence that there is any damage, it should be disassembled and inspected.

Remove screws and clamp which retain the ball guides in place in the nut; draw guides out of nut. Turn nut upside down over a suitable receptacle for the balls. Rotate shaft and worm back and forth until all balls have dropped out of nut. The nut can then be drawn endwise off the worm.

Inspection

Wash all parts in cleaning solvent, and thoroughly dry them with clean rags. Inspect roller-bearing cones, thread grooves of worm and nut, and surface of all balls for signs of any indentations due to severe impact, and for any signs of chipping or breakdown of the surfaces.

NOTE—A magnifying glass will be of considerable value in making the above inspection.

Any parts which show signs of damage should be replaced. Balls must be replaced only with genuine balls furnished by the manufacturer. No commercial balls should be used regardless of grade or quality. Inspect pitman shaft for wear and check the fit of the pitman shaft in the housing bushings. Worn bushings may be removed and replaced, using special driver, J-1614.

The bushings are machined to permit pressing them into the housing without reaming. Inspect fit of the pilot on the end of the pitman shaft in its bushing in the side cover. In the event this bushing

is worn, a new side cover and bushing assembly should be installed, as it is impractical to replace this bushing in the field.

Reassembly of Ball Nut

1. Place shaft and worm in horizontal position on bench, and slip the nut onto the worm with ball guide holes up. Align thread grooves in worm and nut by sighting them at bottom of ball guide holes.
2. Count 30 balls into a suitable container; this is the proper number for one circuit.
3. Drop balls from the count container into one of the ball guide holes, turning the worm gradually away from that hole, until the ball circuit is full, or until stopped by reaching end of worm thread. In the latter case, hold down those balls already dropped into the nut with the blunt end of a clean rod, and turn the worm in reverse direction for a few turns. The rod may then be removed, and filling the circuit continued until 20 balls are assembled in the nut.
4. Inspect the ball guides for any damage at the ends, where they deflect or pick the balls from their helical path. Any guides showing signs of such damage should be replaced.

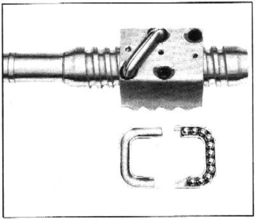

Fig. 5—Installing Balls in Nut and Guide

5. Lay one-half guide, groove up, on the bench, and place the 10 remaining balls from the count container in it (see Fig. 5). Close the guide with another half, hold the two halves together, and plug each end with grease, so that the balls will not drop out. Push the guide into the guide holes of the nut with the fingers, thus completing one circuit of balls. If the guide does not push all the way down readily, it may be tapped into place lightly with the wooden handle of a screwdriver.
6. Fill the second ball circuit in the same manner as described.
7. Assemble ball guide clamp to nut. Be sure to use lockwashers under clamp screws and set the screws up tight.
8. Rotate the nut on the worm to see that it moves freely, but take care that it does not move far enough to be stopped by the ends of the worm thread. If there is any stickiness in the motion of the nut, it is possible that some slight damage to the ends of the ball guide has been overlooked. Lay the assembly in a horizontal position, to make sure that the nut does not run to the end of the worm thread of its own weight.

Reassembly

1. Thread the main shaft with the upper roller bearing into the housing.

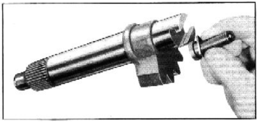

Fig. 6—Installing Lash Adjuster

2. Replace end cover with lower roller bearing, using a new gasket. After making sure that there is some end play in worm, assemble end cover bolts and lockwashers.
3. Assemble lash adjuster with shim in slot in end of pitman shaft, Fig. 6; check the end clearance, which should not exceed .002″. For the purpose of adjusting this end clearance, a steering gear lash adjuster shim unit, Part Number 605142, has been released. It contains four shims of the following thickness: .063″, .065″, .067″ and .069″.
4. After the lash adjuster end clearance has been adjusted, start the pitman shaft pilot into bushing side cover. Then, using a screwdriver through the hole in cover, turn lash adjuster in a counter-clockwise direction to pull the pitman shaft pilot into its bushing.
5. Rotate mainshaft with fingers until ball nut is approximately in center of travel. Make sure that rack and sector will engage properly (that is, with center tooth of one entering tooth space of the other) and push side cover assembly, including pitman shaft and side cover gasket into place. After making sure that there is some lash between the rack and sector teeth, assemble and tighten side cover bolts and lockwashers.
6. Adjust steering gear according to instructions given under the heading "Adjustment."

Mast Jacket Bearing

The mast jacket bearing located at the top of the mast jacket is a spring-loaded ball bearing contained in a metal retainer. It will very rarely require any attention, however, it should be checked during a steering gear overhaul job. Should it require replacement, the old bearing may be driven out with a long rod working through the housing after the main shaft has been removed. To replace the bearing assembly, start it into the top of the mast jacket, then using a block of wood tap it down until the flange on the bearing retainer engages to top of the mast jacket.

Replacement in Chassis

1. Thread the steering gear over the clutch and brake pedals in through the left door, moving it downward to position at the frame side rail. Install housing mounting bolts loosely at frame.
2. Install mast jacket to instrument panel bracket, tightening the "U" clamp just enough to position the mast jacket. Align the steering gear and tighten the housing mounting bolts securely. Tighten "U" clamp at mast jacket to instrument panel bracket.
3. Install left engine side pan by replacing two rear bolts and one side bolt.
4. Assemble pitman arm, lockwasher and nut. Tighten the nut securely, using an 18-inch wrench. Assemble the steering connecting rod by following instruction given at the end of this section.
5. Set wheels in straight-ahead position and install steering wheel. Place one spoke toward driver; then tighten nut securely and stake end of shaft to keep nut from turning. Connect horn wire and adjust horn button blowing contact pressure.
6. Install clevis pin at the brake lever pull rod at the idler lever.
7. Install floor and toe-boards.
8. Lubricate the steering gear according to the instructions given in the Lubrication Section.

Horn Blowing Button Adjustment

Horn button contact is adjusted by loosening the lower hub housing clamp screw, and turning the housing until the desired horn button blowing pressure is secured; then tighten the clamp screw. Fig. 7 shows the location of the clamp screw.

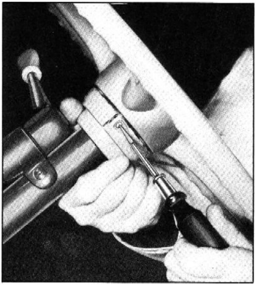

Fig. 7—Horn Adjusting Hub Clamp Screw

Steering Connecting Rod

The steering connecting rod is a ball and socket type. Ball seats, springs and adjusting plugs are identical, the only difference being in the length of the safety plugs.

When assembling the parts in the rod ends, make sure they are assembled in the order shown in Fig. 8, as this method of assembly relieves road shocks from steering gear in both directions.

To adjust the ball joints, screw end plugs in tight, then back off one-half to one full turn. Lock the adjusting plugs with a new cotter pin.

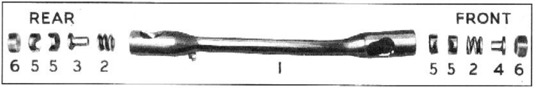

Fig. 8—Layout of Steering Connecting Rod Parts

1—Steering Connecting Rod
2—Tension Spring
3—Rear (long) Safety Plug
4—Front (short) Safety Plug
5—Ball Seat
6—Adjusting Plug

STEERING GEAR TROUBLES AND REMEDIES

Symptom	Probable Remedy
Hard Steering	
1. Lack of lubrication.	1. Lubricate steering gear, tie rod ends and steering connecting rod ball joints.
2. Tie rod end bolts too tight.	2. Readjust tie rod end bolts.
3. Under-inflated tires.	3. Inflate tires to recommended pressure.
4. Improper adjustment.	4. Adjust according to instructions.
Loose Steering	
1. Improper adjustment.	1. Adjust according to instructions.
2. Loose ball joints.	2. Adjust ball joints.
3. Worn steering arm bushings.	3. Replace steering arm bushings.

TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling the steering assembly:

Tool Number	*Description*
J-1025	Pitman Arm Puller
J-1618	Steering Wheel Puller
J-1614	Pitman Shaft Bushing Remover and Replacer
J-544-A	Steering Gear Checking Scale

STEERING GEAR SPECIFICATIONS

Type .... Ball Sector Type

Gear Ratio .... 19.8 to 1

BEARINGS

Worm .... Barrel Roller

Worm Nut .... Ball

Ball Diameter (Nominal) .... 9/32″

Quantity of Balls 60

Sector Shaft .... Bushings

STEERING WHEEL

Diameter .... 17″

STEERING CONNECTING ROD

Type .... Spring Loaded

Adjustment .... Threaded Plug

SERVICE DATA

STEERING GEAR

Worm Shaft Adjustment.... Tighten adjusting nut to obtain 1 Lb. to 1½ Lbs. rim pull at steering wheel, with steering connecting rod disconnected.

Sector Shaft Thrust Adjustment.... Tighten adjusting screw to obtain 2 Lbs. to 2½ Lbs. rim pull at steering wheel through center of travel, with steering connecting rod disconnected.

Sector Shaft End Play .... .000″—.002″

CLEARANCE BETWEEN

Sector Shaft and Bushing
- Outer .... .0035″—.0045″
- Inner (In Cover) .... .0015″—.0025″

Sector Shaft Bushing Diameter
- Inner (In Cover)............ 1.248″—1.250″
- Outer .... 1.248″—1.2495″

Section 10

WHEELS AND TIRES

INFLATION PRESSURES

Maintaining the correct inflation pressures is one of the most important elements of tire care. The inflation pressure recommended for any model truck is carefully worked out as the best pressure to give an efficient balance of the following factors of good performance: comfortable ride, stability, steering ease, even tread wear, tire cord life and immunity from blowouts.

It is recommended that tires in ordinary use be checked for proper pressure once each week. This will result in added tire life as 2 pounds pressure will normally be lost in a week of ordinary driving. Trucks operated at high speeds or in more than ordinarily severe service should have the tires checked at more frequent intervals.

Inflation pressures are extremely important in truck tires. The tires should always be inflated so that the full width of the tire tread is in firm contact with the road and that a normal amount of bulge shows on the sidewall of the tire at the bottom. It is extremely detrimental to have the sidewalls of the tire bulge too much and it is also detrimental to tire life to have the sidewall bulge too little. The correct bulge for any tire is obtained by loading the tire to the maximum rated load and inflating it with the corresponding inflation pressure shown.

Truck tires are expensive and will deliver many more dollars worth of miles if they are properly inflated and proper care taken of all cuts and bruises.

TESTING FOR TIRE NOISE

The determination of whether tires are causing a noise is relatively simple. The truck should be driven at various speeds and note taken of the effect of part throttle, sudden acceleration, and deceleration on the noise condition, as axle and exhaust noises show definite variations under these conditions, while tire noise will remain constant; however, the pitch of the noise will change with the speed. Tire noise is most pronounced at speeds of approximately twenty or thirty miles per hour.

The tire noise may be further checked by driving the truck over smooth pavements or dirt roads (not gravel) with the tires at normal pressure and again over the same stretch of road when the tires have been inflated to fifty pounds pressure. If the noise for which the test is being made is caused by tires, it will noticeably decrease when the tire pressure is increased, whereas, rear axle noise should show no change in volume as a result of changes in tire pressures.

If, on inspection, the tires on the front wheels are found to be creating most of the noise, the alignment of the front wheels should be checked, as excessive tire noise usually results from low tire pressure, incorrect alignment or from uneven tire wear.

CORRECTION OF IRREGULAR TIRE WEAR

Since irregular tire wear is due to some action which causes certain places on a tire to wear more rapidly than others, the remedy is naturally to correct the condition causing the wear. However, after the adjustments have been made, it is wise to interchange the tires which will equalize the future normal wear which will occur.

Tires may be alternated several ways to even up irregular wear. However, the following method is the simplest and, in most cases, the most satisfactory.

Wheels should be changed without dismounting the tires, right front to left rear, and left rear to right front; left front to right rear, and right rear to left front.

HEEL AND TOE WEAR

Heel and toe wear is a saw-tooth effect with one end of each tread block worn more than the other.

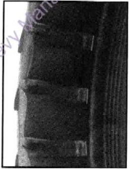

Fig. 1—Heel and Toe Tire Wear

The end which wears is that which first grips the road when the brakes are applied. High speed driving and excessive use of the brakes will cause this type irregular tire wear, on any type tread design. Heel and toe wear is not so general on the rear tires because of the propelling action creating a counteracting force which wears the opposite end of the tread blocks. These two stresses on the rear tires cause the tread blocks to wear in opposite directions and produces more even wear, while on the front tires, the braking stress is the only one effective. An example of heel and toe wear is shown in Fig. 1.

Fig. 2—Tire Wear Due to Improper Camber

SIDE OR CAMBER WEAR

There are several reasons why tires wear more rapidly on one side of the tread than on the other:

1. Wheel camber causes the tire to run at a certain angle from the perpendicular, resulting in side wear. Fig. 2 shows an example of side wear caused by excessive camber. This condi-

tion may be corrected by correcting the camber and interchanging the tires.

2. High crown or high cambered roads cause an increased wear on the side of the right front tire.

3. Side thrust when rounding turns causes wear on the sides of the treads. In making a turn to the left, especially at high speeds, the outside shoulder of the right tire and the inside shoulder of the left tire take most of the wear. When making a right hand turn, the opposite shoulders of the tires are worn.

4. Excessively low inflation will also cause undue wear on the sides of the tires. Under no circumstances should the pressure be allowed to drop below the minimum pressure recommended for the particular truck and size of tire. In general, tires should be inflated a few pounds above the minimum pressure recommended. See "Inflation Pressure."

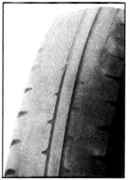

Fig. 3—Tire Wear Due to Under Inflation

An example of two-sided wear is shown in Fig. 3. This has been caused by low inflation and may be corrected by bringing the inflation up to the pressure recommended by the truck manufacturer if normal loads only are being carried. If abnormally heavy loads are being carried, the inflation should be increased so that the tire shows only a normal amount of deflection or bulge at the point of contact with the road.

TOE-IN OR TOE-OUT MISALIGNMENT WEAR

When there is excessive toe-in or toe-out, tires will revolve with a side motion and scrape the tread rubber off. If the misalignment is severe the rubber on both tires will be scraped off, but if the misalignment is slight or is caused by a bent steering arm, the rubber on only one tire will be scuffed off.

Fig. 4—Tire Wear Due to Improper Toe-In or Toe-Out

The scraping action against the face of the tire causes a small feather edge of rubber to appear on one side of the tread design. This feather edge is the evidence of irregularity as shown by the arrows in Fig. 4.

UNEVEN TIRE WEAR

Other types of uneven tire tread wear are due to some irregularities, such as uneven caster, bent axles, wobbly wheels, out-of-round brake drums, unequally adjusted brakes, or other mechanical difficulties, Fig. 5, and can be corrected only by correcting the conditions which are causing it. Too much toe-in or toe-out combined with under-inflation will also cause uneven tire wear.

Fig. 5—Wear Due to Mechanical Condition

In the case of dual rear wheels, when it is necessary to interchange tires, always place the tire showing the most wear on the inside dual, and the tire with the least wear on the front wheels. The reason for this is simply that the inside dual tire is the hottest running tire on a truck, the outside dual next, and the front tire is the coolest, and it goes without saying that the less rubber on a tire, the cooler it will run.

TIRE BALANCE

Original equipment tires and tubes are marked at source, so that the light portion of the casing is counterbalanced by the heavy portion of the tube.

Due to irregularities in tread wear, caused by sudden brake applications, misalignment, low inflation pressure, or tube and casing repairs, a casing and tube assembly can lose its original balance. If a disturbance is felt in the steering wheel due to the action of the front wheels, the first items to check are pressures and the balance of the tire and wheel.

BALANCING WHEELS AND TIRES

Wheel balance is the equal distribution of the weight of the wheel and tire assembly around the axis of rotation. There are two ways in which every wheel must be balanced—statically and dynamically.

STATIC BALANCE

Static balance (sometimes called still balance) is the equal distribution of the weight of the wheel and tire assembly about the axis of rotation in such a manner that the assembly has no tendency to rotate by itself, regardless of its position. For example: A wheel with a chunk of dirt on the rim will always rotate by itself until the heavy side is at the bottom. Any wheel with a heavy side like this is statically out of balance. Static unbalance of a wheel causes a hopping or pounding action (up and down) which frequently leads to wheel "flutter" and quite often to wheel "tramp."

DYNAMIC BALANCE

Dynamic balance (sometimes called running balance) means that the wheel must be in static balance and also run smoothly at all speeds on an axis which runs through the center line of the wheel and tire, and is perpendicular to the axis of rotation. To explain the principle of dynamic balance, let us first consider what happens when we swing a weight attached to a string. If we start to swing this weight slowly, it is apparent that the weight swings in a sharp angle with reference to the axis of rotation (the hand). If the speed is increased, the weight climbs until the weight mass is at right angles to the axis of rotation. Now, let us apply this principle to a spinning wheel.

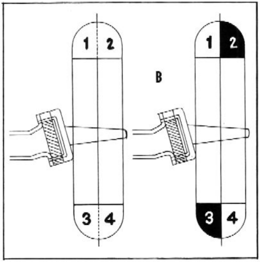

Fig. 6—Wheel in Static Balance

By referring to Fig. 6-A, it can be seen that when a wheel and tire assembly is in static balance, the sum of the weights of sections 1 and 2 is equal to the sum of the weights of sections 3 and 4; or, in other words, the weight is equally distributed about the axis of rotation. Fig. 6-B is a drawing of a wheel that is in static balance because the shaded heavy point 2 is balanced by the shaded heavy point 3. However, it can be seen that with reference to the center line, section 1 is lighter than section 2, and that section 4 is lighter than section 3.

When we start to spin this wheel (as in Fig. 7-A) the center line of the weight masses 2 and 3 tries to get at right angles to the axis of rotation, just as the weight on the string tried to get at right angles to its axis of rotation (the hand). This tendency to get at right angles exerts a force on the wheel (as shown by the arrows). This force, in turn, tends to move the center line of the wheel, and, in so doing, distorts the axis of rotation.

When the wheel has turned 180°, the forces exerted by the heavy sections 2 and 3 now tend to move the center line of the wheel in the opposite direction. In other words, the wheel tries to rock first in one direction, then in the other.

The result of the movement of these unbalanced forces causes the wheel to wobble or shimmy, and the condition becomes more violent with increased speeds.

To correct this condition we must add weight to sections 1 and 4, so they will be equal to the weight of sections 2 and 3. Notice that this addition of weight now distributes the total weight evenly about

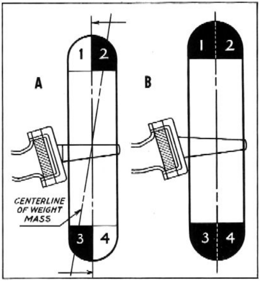

Fig. 7—Wheel in Static and Dynamic Balance

both the axis of rotation and the center line of the wheel as seen in Fig. 7-B. Therefore, this wheel is now both statically and dynamically balanced.

Wheels must be both statically and dynamically balanced to give maximum steering ease and stability at speeds where unbalance becomes noticeable. The wheels must be statically balanced before they can be balanced dynamically. To demonstrate the balancing of a wheel assembly we will use a combination of static and dynamic wheel balancer, as shown in Fig. 8.

Before the wheel assembly is balanced, the wheel and tire must be clean and free from all foreign matter. The tires should be in good condition and properly mounted, with the balance mark on the tire lined up with the valve stem in the tube. Bent wheels that have a run-out of over 3/16" should either be replaced or straightened before being balanced.

CHECKING FOR STATIC BALANCE

The static balancer operates on the principle of the pendulum and lever arm. The pendulum is mounted free to pivot, as shown in Fig. 8. An extension of the pendulum rod with suitable cones forms an arbor for the wheel which is to be balanced. Any unbalanced weight on the wheel assembly when mounted on the arbor acts through the wheel as a lever arm and tends to move the pendulum off center. The amount of movement depends upon the amount of unbalanced weight,

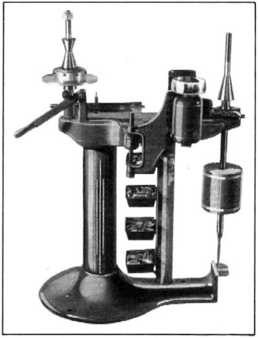

Fig. 8—Dynamic Wheel Balancer

and is indicated on the scale below by the pendulum pointer. Before placing a wheel on a static balancer, be sure that the pendulum pointer falls directly over the center mark on the scale. If it does not, the scale may be moved slightly to either side to compensate. To static balance a front wheel, place the wheel on the static arbor with the brake drum up. Using the regular wheel bearings between the special balancing cones, tighten the arbor nut (with fingers) sufficient to remove play and so that the wheel rotates easily.

When placed in a horizontal position, as in this test, every wheel and tire assembly will have a place where it balances statically. Obviously, this place will be through the center of the heavy section of the wheel. Therefore, with the wheel in position on the arbor, turn the wheel slowly until in balanced position (balanced position is determined when the pointer on the pendulum rests directly over the center line of the scale). Now place the adjusting rod (furnished with the machine) on the arbor so that the mark "1" is directly in line with the mark stamped on the end of the arbor. Now raise or lower the counterweight by turning right or left until the pointer on the pendulum swings over the line between the "poor" and "danger" zones. The adjusting rod and weight are used in connection with each other to calibrate the sensitivity of the machine.

NOTE—The machine should be calibrated each time a different wheel is balanced.

When the adjusting rod is removed from the arbor, the pointer should return over the center line. If it does not, turn the wheel a few inches in either direction until the pointer is directly over the center line. With the pendulum weight properly calibrated, we are now ready to balance the wheel.

Replace the adjusting rod on arbor with mark "1" directly in line with mark on end of arbor and then chalk the tire directly below the rod. Without moving the wheel, turn the adjusting rod so that mark "2" is directly in line with the mark on the arbor, and again chalk the tire directly below the rod. Again, turn the adjusting rod 90° to the third position and make a third chalk mark on the tire. Repeat this operation and make a fourth chalk mark on the tire.

Now, with the adjusting rod still on the arbor with one of the marks lined up with the mark on the arbor, turn the wheel assembly 90° ($\frac{1}{4}$ turn) and then remove the adjusting rod. Indicator pointer at bottom of pendulum will now show condition of the static balance of the wheel assembly. Place necessary weight (or weights) on rim of wheel at chalk mark on right (or high) side of wheel until pointer returns to center line. If two weights are required, they should be placed at equal distances from chalk mark. When proper weight has been determined, fasten securely to rim of wheel.

After the wheel assembly has been statically balanced, it should be rotated in short steps, making a complete turn to determine whether the assembly is now balanced statically in all positions.

CHECKING FOR DYNAMIC BALANCE

A dynamic balancer is composed of the dynamic arbor and leveling plate assembly. The leveling plate assembly is in turn composed of the floating spindle integral with the ball which forms the leveling plate seat, the leveling plate and the mounting cones. (See Fig. 9.) In operation the leveling plate assembly floats free of the dynamic arbor so that any wobble in the wheel will be shown. The leveling plate is a snug fit on its ball seat so that it rotates with the wheel, but may be tilted up or down in relation to the spindle.

After the wheel assembly has been statically balanced, it is ready for dynamic balancing. With the wheel bearings in place, lower the wheel assembly

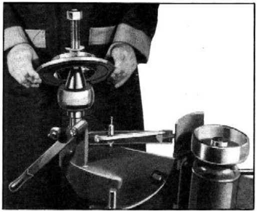

Fig. 9—Installing Leveling Plate

onto the dynamic spindle with the brake drum down. Place the small cone over the spindle and adjust the nut snugly so the spindle will rotate with the wheel and not turn separately. Adjust motor height so that the drive pulley contacts the center of the tire; start motor and revolve wheel for 20 or 30 seconds, after which the motor can be switched off and the pulley released from contact with the tire.

When a wheel revolves at high speed on a floating spindle, any uneven weight distribution will cause the wheel and floating spindle to change its axis of rotation so that the center line of the weight mass becomes horizontal—or perpendicular—in relation to the dynamic arbor, just as the weight on the string became perpendicular in relation to the hand.

With the wheel still revolving at high speed, carefully raise the leveling handle until the fibre button contacts the leveling plate continuously and the plate runs true. Then lower the leveling handle and apply the brake to the tire in order to bring the wheel to a complete stop. When leveled in this manner, the leveling plate is brought into parallel with the center line of the wheel mass, but not necessarily in parallel to the wheel itself because, if the wheel was dynamically out of balance, the wheel and leveled plate are not in parallel.

Raise the indicator hub carefully into the arbor socket, lifting it as far as possible and holding it there firmly. This operation brings the wheel into perpendicular with the dynamic arbor, and at the same time tilts the leveling plate so that it now has the same tilt or wobble that was formerly in the spinning wheel. Thus, when a reading is taken from the leveling plate, it will show the amount and location of the dynamic unbalance in the wheel.

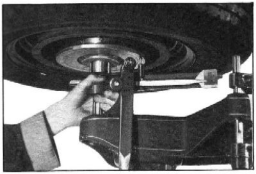

Fig. 10—Setting Indicator Pointer to "O"

CAUTION—Do not disturb the leveling plate during this operation.

With the indicator hub still raised, it will be found that the little brass pin which actuates the pointer on the indicator hub is in contact with the leveling plate. Now, revolve the wheel slowly by hand until the pointer on the indicator reaches its lowest position. Then set the scale so that the end of the pointer reads on "0." (See Fig. 10.)

Turn the wheel 180° (½ way), and read the total number of graduations that the pointer moves upward on the scale. At this position (the high point) chalk the tire directly above the pointer, but on the underside of the wheel. We are now ready to attach the weights.

The amount of weight required varies according to the size and weight of the wheel assembly. Heavy wheels require more weight than light wheels. Chevrolet wheels require about 1 ounce of weight for each graduation mark indicated on the scale. After the amount of weight has been determined, it must be remembered that one-half of the required weight is placed on the underside of the rim and the other one-half of the weight placed 180° away (opposite) and on the upper side of the rim. Correcting weights must be accurately divided in order to retain the static balance of the assembly.

Place one-half the amount of weight needed at the chalked position on the lower side of the rim. Place exactly the same amount of weight directly opposite (180°) the chalk mark, but on the upper side of the rim. Be sure the weights are tapped on securely as the tire bead rusted to the rim sometimes prevents complete contact.

In order to make sure that the wheel is in perfect dynamic balance, recheck for accuracy in accordance with the procedure outlined above. Should the pointer indicate that the wheel is still unbalanced, it is evident that incorrect weight was used to balance the wheel. If the pointer is at the extreme low position directly below the lower weight, it indicates that too much weight was used. Should the pointer be at the high position directly under the lower weight, it indicates insufficient weight. Should any changes in weight be found necessary, it is suggested that the wheel again be rechecked for accuracy after corrections have been made.

There may be some cases where it is necessary to statically balance rear wheels to correct a hopping condition at the rear end. To do this, the rear wheels may be adapted to the static arbor by use of face plates, or used in conjunction with a perfectly balanced front wheel hub and brake drum assembly.

WHEEL AND TIRE SPECIFICATIONS

TRUCK MODEL	TIRE SIZE	PLY	TIRE PRESSURE	
			FRONT	REAR
½ Ton	6.50-16	6	30	40
½ Ton	15"	6	20	35
¾ Ton	15"	6	20	35
1½ Ton	7.50-20	8	40	55

Section 11

CHASSIS SHEET METAL

The Front End Sheet Metal Assembly is attached to the radiator support at the front and to the running boards and cowl at the rear.

The radiator support is fastened to the frame front cross member by two bolts through a rubber mounting. This method of mounting prevents frame distortions from being transmitted to the front end sheet metal assembly when the vehicle is being driven over uneven terrain.

Removal as a Unit

1. Remove the hood and radiator brace rods.
2. Drain the radiator and disconnect all hose connections.
3. Disconnect electrical wiring at the junction block on each side.
4. Remove fender to running board bolts, also the fender to cowl bolts on each side.
5. Remove the front bumper at frame horns.
6. Remove the nuts from the bolts which attach the radiator support to the frame front cross member and remove the bolts.
7. Slide the front end sheet metal assembly forward until the fan shroud (on 1½-ton models only) clears the fan blades, then lift the assembly off the chassis.

Fender Removal

1. Raise the hood.
2. Disconnect electrical wiring at the junction block.
3. Remove bolts which attach fender to running boards.
4. Remove bolts which attach fender and fender skirt to cab cowl.
5. Remove bolts which attach fender to radiator grille and lift off the fender and skirt.

Replacement of the fender is the reverse of the removal operations.

Radiator Core Removal

1. Remove hood, and radiator brace rods.
2. Drain the radiator and disconnect all hose connections.
3. Remove wiring harness from clips that hold it to radiator support and also to top tank of radiator.
4. On models equipped with radiator shroud, remove fan blades.
5. Remove six cap screws (three each side) that hold radiator core to radiator support.
6. Tip top of radiator backward and work past fan (½-ton models) or past pump (on 1½ ton models), and lift up and out.

Headlamp Removal

1. Disconnect electrical wiring at junction block.
2. Reaching under fender, pull wiring out.
3. Remove three nuts from bolts holding headlamp to fender, two at front and one at rear.
4. Lift headlamp from fender.

Section 12

ELECTRICAL SYSTEM

The electrical system consists of a battery, generator, current and voltage regulator, starting motor, ignition apparatus and lighting system connected by wiring harnesses.

The wiring harnesses are protected with flexible conduit to prevent chafing at points where contacts are made with the body and chassis. The wiring is adequately supported by clips, and where necessary, rubber grommets are used to prevent chafing. All terminals are securely soldered to wires to provide good electrical connections.

In the maintenance of the electrical system, the most important single factor is—to keep all connections clean and tight. Loose or corroded connections will cause run down batteries, hard starting, and dim lights. Regular inspection of all electrical connections is the best safeguard against failures in the electrical system.

BATTERY

The battery is a 15-plate, 6-volt battery having a rated capacity of 100 ampere-hours. It is mounted in a sturdy hanger and attached to the right side rail where it is easily removed or serviced by means of an inspection cover located in the floor board. To remove the battery, it is necessary to loosen the hanger through bolts, disconnect the ground strap and positive cable, then lift the battery up through the inspection cover hole.

The battery should be checked once a week to obtain maximum service. Test each individual cell with a hydrometer, and at the same time add distilled water. Each cell is equipped with a non-overfill cap to prevent over-filling the cell with resultant loss of electrolyte. This device comprises a lead sleeve which is threaded in its inner diameter for the filler cap. When the cap is screwed down into place, the lead sleeve is lifted and held in the upper position, uncovering the vent hole for the battery cell. This permits the gases to escape through the vent in the cap as shown in Fig. 1.

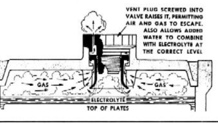

Fig. 1—Battery Cell Cap in Position—Vent Open

When the vent cap is removed for checking or filling a cell, the lead sleeve drops down by its own weight and covers the vent hole to the cell, and the bottom of the sleeve is then within ¼" above the top of the plates. Water may then be added to the battery until it reaches the bottom of the sleeve; the air is then trapped in the expansion chamber of the cell because its vent hole is covered, Fig. 2, thus preventing any further filling of the battery. When the filler cap is replaced, the cell vent is automatically opened as explained in the foregoing.

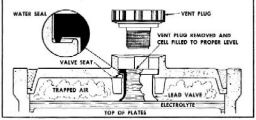

Fig. 2—Battery Cell Cap Removed—Vent Closed

When batteries are removed from cars or trucks for charging, the battery is properly vented when the cell caps are screwed tightly in place. This note appears on each cap: "Keep Plug Tight While Charging."

Where cell caps are left off batteries on the charging line to facilitate periodic checking of specific gravity, proper venting may be accomplished by lifting the lead sleeve of each cell and turning it clockwise or to the right so that the two tangs of the valve rest on the raised lip of the seat. Do not fill the battery with distilled water when the lead sleeve is in this position.

To check the battery and fill it with distilled water, lift off the inspection cover and remove the vent caps from the battery. Check the specific gravity of each cell with a reliable hydrometer. A fully charged battery will show a reading of 1.275 to 1.300. A completely discharged battery will show a hydrometer reading of approximately 1.150. Should a hydrometer reading be between 1.200 and 1.240, the battery should be recharged and the cause of the partially discharged condition investigated.

After testing, the battery should be filled with distilled water as explained in the foregoing instructions.

The battery terminals must be kept tight and free of corrosion, because loose or dirty terminals will cause the battery to become discharged due to increasing the resistance of the charging circuit. To clean the cable terminals remove them from the battery, scrape all corrosion from the inside of the terminal and then wash them off in a strong ammonia and water solution.

Battery must be kept tight in its hanger at all times to prevent physical damage to the elements inside the battery.

THE GENERATOR

The function of the generating system may be summed up as follows: It converts a small amount of mechanical energy from the engine into elec-

trical energy which is carried through the wiring to the battery where it is stored for future use. In actual operation some of the energy may be used directly from the generator, but for explanatory purposes it is assumed to flow from the generator to the battery and then be drawn from the latter.

The generator used on this truck is a two-brush shunt wound machine controlled by a combination current and voltage regulator of the vibrating type. The two regulating units operate independent of each other.

The voltage regulator controls the maximum voltage of the generator and keeps it from exceeding a predetermined value fixed by the setting of the regulator. The actual charging rate to the battery varies, depending on the state of charge in the battery.

The current regulator controls the maximum amperage output of the generator and prevents it from exceeding 25 amperes, which is the setting of the current regulator, thereby preventing damage to the generator due to overload.

The shunt wound generator controlled by current and voltage regulation is an ideal generating unit which has the ability to supply the necessary current for lights and accessories in addition to charging the battery.

Maintenance

The two hinge cup oilers should be supplied with 8 to 10 drops of light engine oil every 1000 miles of operation. Do not oil excessively.

At regular intervals, the cover band should be removed and the commutator and brushes inspected. If the commutator is dirty it may be cleaned with No. 00 sandpaper, then blow out the dust. Never use emery cloth to clean commutator.

If the commutator is rough or has high mica, the generator should be disassembled and the commutator turned down in a lathe and the mica undercut.

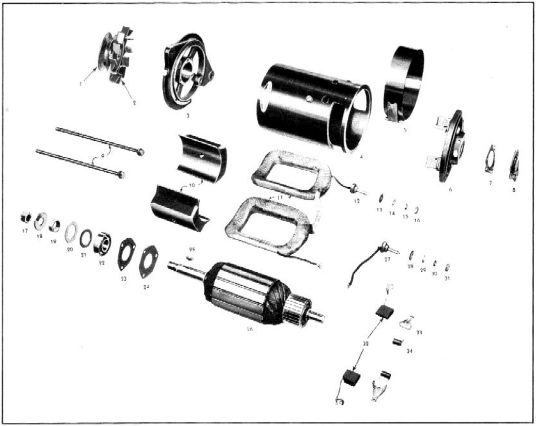

Fig. 3—Layout of Generator Parts

1—Pulley
2—Fan (Part of Pulley)
3—Frame, Drive End
4—Field Frame
5—Band
6—Frame with Pins, Commutator End
7—End Frame Cover Gasket
8—Commutator End Frame Cover
9—Through Bolt
10—Pole Shoe
11—Field Coils
12—Stud
13—Insulation Washer
14—Flat Washer
15—Lockwasher
16—Nut
17—Nut
18—Washer
19—Spacer Collar
20—Retainer
21—Felt Washer
22—Bearing
23—Retainer Plate Gasket
24—Retainer Plate
25—Key
26—Armature
27—Terminal Stud and Lead
28—Insulation Washer
29—Flat Washer
30—Lockwasher
31—Nut
32—Brush
33—Brush Arm
34—Brush Spring

Worn brushes should be replaced. Brushes may be seated with a brush seating stone (available through United Motors Service). It is made of an abrasive material which, held against the revolving commutator, carries under the brushes and seats them in a few seconds. When brushes are seated the dust should be blown out with compressed air.

Low or No Charging Rate

With this condition it is necessary to determine whether the trouble lies in the charging circuit, regulator, or generator.

1. Check the circuit for loose connections, corroded battery terminals and loose or corroded ground strap. The high resistance resulting from these conditions will prevent normal charge from reaching the battery. If the entire charging circuit is in good condition, then either the regulator or generator is at fault.
2. With a jumper wire connect the field and armature terminals of the generator. Increase the generator speed momentarily and check the output. If the output increases, the regulator requires attention. If the output does not increase, a further check is necessary.
3. Remove the armature wire from the generator and connect the field and armature terminals with a jumper wire. Increase the generator speed momentarily and flash the armature terminal with a screw driver or a pair of pliers. If no spark occurs the trouble is in the generator and it should be removed and overhauled.

Removal of Generator

Disconnect the field, armature and ground wires from the generator. Remove the generator brace nut, fan belt and bracket bolts, then remove the generator from the engine.

DISASSEMBLY

Place the generator in a bench vise. Use the vise as a holding fixture only, being careful not to pinch the generator frame. Remove the generator pulley. Remove the commutator cover band, brush lead machine screws, through bolts and commutator end frame assembly from the generator.

Remove the drive end frame and armature assembly. Remove the drive end bearing inside retainer plate, drive end bearing outside space collar and felt washer from the armature shaft. The drive end bearing should then be removed from the end of the armature shaft. Remove the drive end bearing inside spacer washers, retainer plate and gasket.

With the generator completely disassembled, wash all parts in cleaning solvent.

The illustration (Fig. 3) shows a layout of the generator parts.

Testing Generator Parts

Field Coil Test for Continuous Circuit: Disconnect grounded end of field winding from generator frame. Place the test prods on the field coil leads as shown in Figure 4. If the test lamp lights, the field coils are OK. If the test lamp does not light, the field coils are open-circuited and should be replaced.

Field Coil Test for Ground: Place one test prod on the generator frame and the other on the field

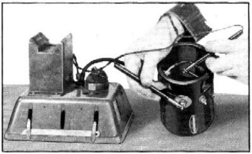

Fig. 4—Field Coil Test for Continuous Circuit

terminal. (See Fig. 5.) If the test lamp lights, field coils are grounded and should be replaced. If test lamp does not light, field coils are OK.

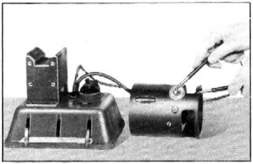

Fig. 5—Field Coil Test for Ground

Field Coil Balancing Test: Slide the insulation off the soldered connection between the two field coils. This test is made with a battery, an ammeter and two leads. Place one test lead on the soldered connection and the other on one end of the field coil. (See Figure 6.) Take a reading on the ammeter. Remove the lead from the end of the field coil and place it on the end of the other field coil and take a reading. If one field coil draws more current than the other, there is an internal short in the field coil and the coil that draws the most current should be replaced.

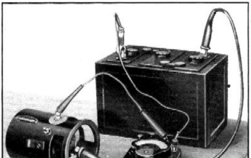

Fig. 6—Field Coil Test for Internal Short

Brush Lead to Generator Negative Terminal Test for Continuous Circuit: Place test prods, one on end of wire and the other on the terminal as shown in Figure 7. If the test lamp lights, the wire is OK. If test lamp does not light, the wire is open circuited and should be replaced.

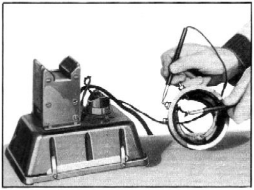

Fig. 7—Terminal Test for Continuous Circuit

Generator Negative Terminal Test for Ground: Place one test prod on the terminal and the other on the generator frame. (Figure 8.) If the test lamp lights, the terminal insulation is broken down and should be replaced. If the lamp does not light, the insulation is OK.

Main Brush Test for Ground: Place test prod leads—one on the negative brush and the other on the end frame. (Figure 9.) If the test lamp lights,

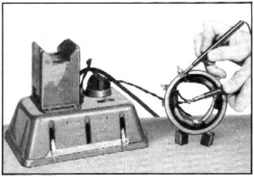

Fig. 8—Terminal Test for Ground

the negative brush holder is grounded and it should be replaced. If the test lamp does not light, the brush holder is OK.

Brush Holder Spring Tension: Check to see that the brush holder springs have enough tension to hold the brushes snugly against the commutator. Proper tension is from 24 to 28 ozs. Check brushes for wear and condition. Replace if necessary.

Front Bushing Fit: Check the fit of the armature shaft in the front bushing and if this bushing is worn, replace.

Armature Test for Ground: Place the test prod leads, one to the armature core and the other to the commutator bars as shown in Figure 10. If

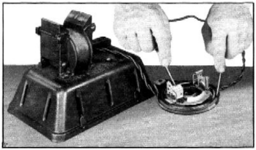

Fig. 9—Negative Brush Holder Test for Ground

the test lamp lights, the armature is grounded and should be replaced. If the test lamp does not light, the armature is OK.

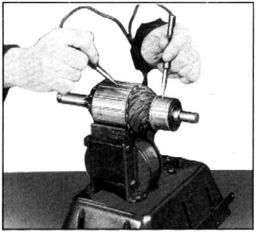

Fig. 10—Armature Test for Ground

Armature Test for Short: Place the armature on the growler, and with a saw blade over the armature core, rotate the armature and test. (See Figure 11.) If the saw blade does not vibrate, the armature is OK. If the saw blade vibrates, the armature is short circuited. To determine whether the armature windings or the commutator is shorted, clean

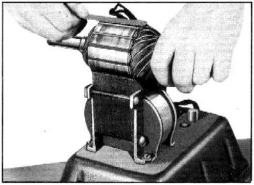

Fig. 11—Armature Test for Short

out between the commutator bars and recheck the armature. If the saw blade still vibrates, the armature is short-circuited and should be replaced.

Armature to Commutator Leads: Check to see that the armature to commutator leads are properly soldered to the commutator. Loose leads should be resoldered using rosin flux.

NOTE—Never use acid flux when soldering electrical connections.

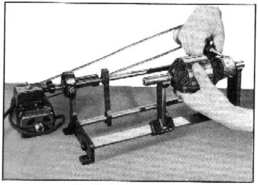

Fig. 12—Undercutting Mica

Commutator: Check the commutator for roughness, and if rough, turn down on a lathe until it is thoroughly cleaned up, after which sand off with 00 sandpaper. Undercut the mica, as shown in Figure 12, and again check the armature on the growler.

Reassembly

After the parts have been thoroughly tested and inspected and worn or damaged parts replaced, reassemble the generator as follows:

1. Assemble the drive end bearing outside retainer and felt washer to the drive end frame. Lubricate the ball bearing with Petrolatum or vaseline, then assemble the bearing gasket and inner retainer plate to the drive end frame. Install the three screws with lockwashers and tighten them securely.
2. Place spacer washer on armature shaft and press armature shaft into bearing in drive end frame. Assemble space collar on armature shaft. Then install woodruff key in shaft and assemble fan and pulley, flat washer, lockwasher and nut to armature shaft. Tighten nut securely.
3. Install screw in field ground connection and tighten it securely, then assemble armature and drive end frame to field frame.
4. Assemble commutator end frame to field frame, install the through bolts and tighten them securely.
5. Install new brushes in the brush holders and connect the field leads.
6. Lubricate the commutator end bearing with engine oil.

Generator Tests

After the generator is completely assembled, and before it is installed on the car the following test should be made:

Motoring Generator: With a battery and an ammeter in the circuit as shown in Figure 13, connect the field and armature terminals with a jumper lead; place one lead on generator terminal and the other to the ground. This will operate the generator as a motor. The ammeter reading, with the generator running, should be from 4 to 6 amperes.

NOTE—It is good practice, after replacing a generator on the car, to use a jumper lead to momentarily connect the battery terminal of the regulator with the generator terminal. This sends a current through the generator windings, assuring that it will build up in the proper polarity.

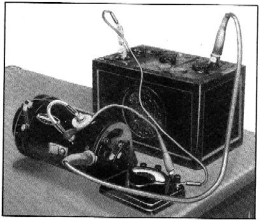

Fig. 13—Motoring Generator

CURRENT AND VOLTAGE REGULATOR CONSTRUCTION

In discussing the construction of the combination current and voltage regulator, we will cover the voltage regulator first, then the current regulator.

VOLTAGE REGULATOR

The voltage regulator unit consists of an iron core, which with its windings forms an electromagnet. The voltage winding consists of a large number of turns of fine wire. One end of this winding is connected to the generator (GEN) terminal of the regulator and the other end of the winding is grounded. This winding is known as a voltage coil because it is connected directly across the generator armature at all times and is subjected to the generator voltage, Fig. 14.

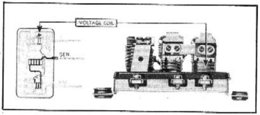

Fig. 14—Regulator Voltage Coil

The series winding on the core consists of a few turns of larger diameter wire, one end of which is connected to the field (F) terminal of the regulator and the other end to the upper point mounting of the current regulator, Fig. 15. This winding

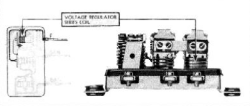

Fig. 15—Voltage Regulator Series Coil

is known as a series coil because it is connected in series with the shunt field of the generator.

An iron armature which carries one of the regulator points is mounted over the magnet core, and is hinged to the regulator body. The other point is mounted to the regulator body. Two coil springs are attached between the armature and body to hold the regulator points closed when the regulator is not operating.

Two field resistance units are mounted on the regulator. However, only the lower resistance unit functions with the voltage regulator. One end of this resistance is connected to field (F) terminal of the regulator and the other end is grounded, Fig. 16.

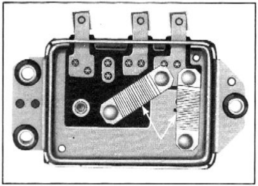

Fig. 16—Regulator Resistance Units

CURRENT REGULATOR

The current regulator unit consists of an iron core, over which is wound a few turns of comparatively large wire. One end of this winding is connected to the generator (GEN) terminal of the regulator and the other end is connected to the series winding of the circuit breaker. This winding is known as a series winding because it is connected in series with the generator armature and all the charging current must pass through it as shown in Fig. 17.

An iron armature which carries one of the regulator points is mounted over the magnet core, and is hinged to the regulator body. The other point is

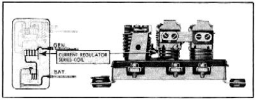

Fig. 17—Current Regulator Series Coil

mounted to the regulator body. Two coil springs are attached between the armature and body to hold the regulator points closed when the regulator is not operating.

The two field resistance units function in parallel with the current regulator. One end of each resistance is connected to the field (F) terminal of the regulator. The other end of the lower resistance is grounded directly, while the other end of the upper resistance is connected to the current regulator armature and grounds through the voltage regulator points when the current regulator points are open.

CURRENT AND VOLTAGE REGULATOR CONNECTIONS

The positive wire from the generator is connected to the generator (GEN) terminal of the regulator; and the field terminal of the generator is connected to the field (F) terminal of the regulator. The wire from the battery through the ammeter to the battery (BAT) terminal of the regulator. These connections are shown in Fig. 18.

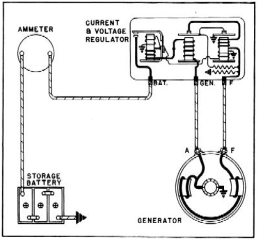

Fig. 18—Generator and Regulator Circuit Diagram

We have described the construction and hookup of the generator and regulator, and we will now take up their operation.

OPERATION

When the engine is started, current for the field circuit flows from the positive brush through the shunt field windings to the F terminal of the gen-

erator, through the wire to the F terminal of the regulator, thence through the series winding on the voltage regulator core, across the current regulator points to the voltage regulator points to ground and back to the grounded negative brush of the generator, completing the field circuit, Fig. 19.

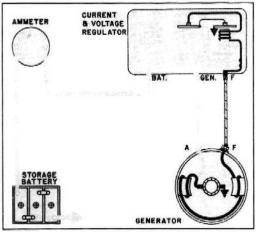

Fig. 19—Field Circuit with Regulator Points Closed

At the same time current flows from the generator positive to the generator (GEN) terminal of the regulator. From this terminal a circuit through the voltage winding of the voltage regulator to ground and back to the grounded negative of the generator is established, Fig. 20. At the same

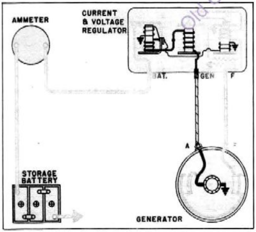

Fig. 20—Voltage Coil Circuit

time a current flows through the series windings of both the current regulator and circuit breaker, thence through the voltage winding of the circuit breaker to ground and back to the grounded negative of the generator.

When the engine speed is increased the generator voltage rises and when it has built up to 6.3 to 6.7 volts, sufficient current is forced through the voltage winding of the circuit breaker to magnetize its core sufficiently to attract the circuit breaker armature and close the points, establishing a circuit from the generator to the battery as shown in Fig. 18.

VOLTAGE REGULATOR

It will be noted by referring to Fig. 20 that the generator voltage is impressed across the voltage winding of the voltage regulator at all times. You will also note that any change in generator voltage will make a corresponding change in the current value passing through the voltage winding of the regulator. Such being the case, the magnetic strength of the voltage winding varies directly as the generator voltage.

As the generator voltage increases to a predetermined value (7.2 to 7.4) fixed by the regulator setting, the magnetic pull on the voltage regulator armature increases until the armature is attracted toward the core, against the spring tension, opening the regulator points.

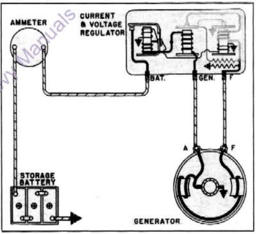

Fig. 21—Field Circuit with Voltage Regulator Points Open

The shunt field circuit must now pass through the resistance unit, Fig. 21. This adds to the resistance of the shunt field circuit, thereby reducing the current value passing through the field winding. The net result of this is a drop in generator voltage. This, in turn, reduces the current value passing through the regulator voltage winding, reducing its magnetic strength, allowing the spring tension to immediately close the regulator points, eliminating the resistance from the field circuit, thus allowing the generator voltage to build up again. This cycle of operation occurs many times per second, resulting in the voltage being held practically constant.

The purpose of the series winding on the voltage regulator is to speed up the vibration of the regulator armature. It will be noted in Fig. 21, that when the regulator points open, the field current passing over the series winding is reduced to zero, resulting in an instant reduction in its magnetic strength, allowing the regulator points to

close more rapidly. This, of course, results in holding the generator voltage nearer a constant value.

CURRENT REGULATOR

When the battery is low and lighting and accessory loads are turned on, the generator voltage may not be forced up high enough to operate the voltage regulator. In this case the current regulator comes into operation.

You will note by referring to Fig. 18 that all the current for lights, accessories and charging the battery passes through the series winding of the current regulator. You will also note that any change in the current output of the generator makes the same change in the current value passing through the series winding of the regulator. Such being the case, the magnetic strength of the current regulator series winding varies directly as the current output of the generator.

As the generator output increases to a predetermined value (34 to 36 amperes fixed by the regulator setting) the magnetic pull on the regulator armature increases until the armature is attracted toward the core, against the spring tension, opening the regulator points.

The field circuit must now pass through the upper resistance unit and across the voltage regulator points to ground, and also through the lower resistance unit to ground in order to complete the circuit. These two resistance units are connected in parallel at this time, Fig. 22.

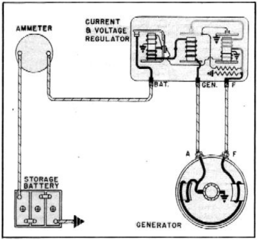

Fig. 22—Field Circuit with Current Regulator Points Open

This adds resistance to the shunt field circuit, thereby reducing the current value passing through the field. This, of course, results in a drop in generator voltage and output. This reduction in current value passing through the series winding of the current regulator reduces its magnetic strength, allowing the spring tension to immediately close the regulator points, eliminating the resistance from the field circuit, thus allowing the generator voltage and output to build up again. This cycle of operation occurs many times per second, resulting in holding the maximum amperage output of the generator at a practically constant value.

QUICK CHECKS TO DETERMINE IF UNITS ARE OPERATING PROPERLY

The following checks must be made to determine whether or not the units are operating normally. If not, the checks will indicate whether the generator or regulator is at fault so that proper corrective steps may be taken:

1. A FULLY CHARGED BATTERY AND A LOW CHARGING RATE indicates normal voltage regulator operation. To check the current regulator remove the battery wire from the battery (BAT) terminal of the regulator. Connect the positive lead of an ammeter to the battery terminal of the regulator and the negative lead to the battery wire. With the ignition switch in the "off" position, step on the starting switch and crank the engine for about fifteen seconds. Then start the engine and, with it running at medium speed, turn on lights, and other electrical accessories and note quickly the generator output, which should be the value for which the current regulator is set.

   Now turn off the lights and other accessories and allow the engine to continue running. As soon as the generator has replaced in the battery the current used in cranking, the voltage regulator, if operating properly, will taper the output down to a few amperes.

2. A FULLY CHARGED BATTERY AND A HIGH CHARGING RATE.

   (a) Disconnect the field wire from the field (F) terminal of the regulator. This opens the generator field circuit and the output should immediately drop off. If it does not, the generator field circuit is grounded either inside the generator or in the wiring harness. If the output drops off to "Zero" with the field lead disconnected, the trouble has been isolated in the regulator. Reconnect the field lead on the field terminal of the regulator.

   (b) Remove the regulator cover and depress the voltage regulator armature manually to open the points. If the output now drops off, the voltage regulator unit has been failing to reduce the output as the battery came up to charge and voltage regulator adjustment is indicated.

   (Instructions for adjusting the regulator are covered under the heading "Voltage Regulator Adjustment.")

   (c) If separating the voltage regulator contacts does not cause the output to drop off, the field circuit within the regulator is shorted and the regulator should be replaced.

3. WITH A LOW BATTERY AND A LOW OR NO CHARGING RATE check the circuit for loose connections, corroded battery

terminals, loose or corroded ground strap, and frayed or damaged wires. The high resistance resulting from these conditions will prevent normal charge from reaching the battery. If the entire charging circuit is in good condition, then either the regulator or generator is at fault.

(a) With a jumper wire ground the field terminal of the regulator to the engine block or other good ground. Increase the generator speed to determine which unit needs attention. Use care to avoid excessive speed since under these conditions the generator may produce a dangerously high output.

(b) If the output does not increase, the regulator needs attention. Check for dirty or oxidized contact points or a low voltage setting.

(c) If the generator output remains at a few amperes with the field terminal grounded, the generator is at fault and should be checked further.

(d) If the generator does not show any output at all, either with or without the field terminal grounded, very quickly disconnect the generator lead from the generator (GEN) terminal of the regulator and strike it against a convenient ground with the generator operating at a medium speed. If a spark does not occur, the trouble has now been definitely isolated in the generator and it should be removed and repaired.

If a spark does occur, likely the generator can build up but the circuit breaker is not operating to permit the current to flow to the battery due to burnt points, points not closing, open voltage winding, grounded circuit breaker, or too high voltage setting.

NOTE—Do not operate the generator with the generator lead disconnected for any length of time since this is open circuit operation and the units will be damaged. A burned regulator resistance unit, regulator winding, or fused contacts can result only from an open circuit operation or extreme resistance in the charging circuit. With these conditions check wiring before reinstalling regulator.

DO NOT RUN OR TEST GENERATOR ON OPEN CIRCUIT. TO DO SO MAY DESTROY REGULATOR OR GENERATOR.

CHECKS AND ADJUSTMENTS

When checking and adjusting current and voltage regulator units, it is essential that reliable instruments be used. A volt ammeter with ¼ ohm variable resistance in series with the ammeter is required for checking and adjusting voltage regulators.

CIRCUIT BREAKER (Cut-Out Relay)

Disconnect the battery wire from the battery (BAT) terminal of the regulator. Connect the positive lead of the ammeter to the battery terminal of the regulator and the negative lead to the battery wire. Connect the positive lead of the voltmeter to the generator terminal of the regulator and the negative lead to ground, Fig. 23. Gradually increase

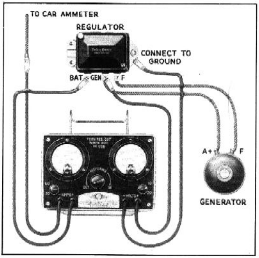

Fig. 23—Volt Ammeter Connections for Checking Circuit Breaker

the engine speed, noting the voltage at which the circuit breaker points close. This should be from 6.3 to 6.7 volts. Slowly decrease the engine speed, noting the discharge current necessary to open the circuit breaker points. This should be from 0 to 4 amperes.

The closing voltage of the circuit breaker may be adjusted by bending the spring post up to increase the spring tension and closing voltage, and down to decrease the spring tension and closing voltage, Fig. 24.

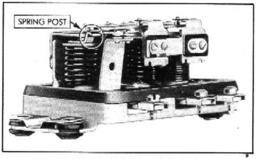

Fig. 24—Circuit Breaker Spring Post

After making the above adjustments, if the reverse current necessary to open the points is not within the limits of 0 to 4 amperes, the following adjustments should be checked:

1. AIR GAP—Place finger on armature directly above core and move armature down until points just close. Then measure the air gap between the armature and center of core,

which should be .020". If both sets of points do not close at the same instant, bend spring fingers so both sets meet simultaneously.

To adjust the air gap, loosen the two screws at the back of the circuit breaker and raise or lower the armature as required. Tighten screws securely after adjustment, Fig. 25.

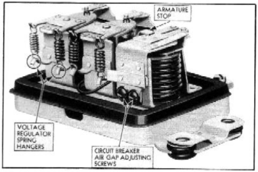

Fig. 25—Voltage Regulator and Circuit Breaker Adjustments

2. POINT OPENING—The opening between the points should be .020". Bend the upper armature stop up to increase the point opening and down to decrease the point opening.

After making the above adjustments the closing voltage and opening amperage should be rechecked and necessary adjustments made.

CURRENT REGULATOR

When checking the current regulator adjustment it is necessary to remove the regulator cover and connect a jumper lead from the voltage regulator upper point support bracket to the armature. This shorts the voltage regulator points and prevents them from operating while the current regulator is being checked, Fig. 26.

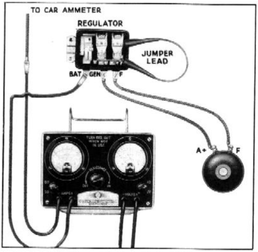

Fig. 26—Volt Ammeter Connections for Checking Current Regulator

Remove the battery wire from the battery terminal of the regulator and connect the positive lead of the ammeter to the battery terminal of the regulator and the negative lead to the battery wire. Make sure that the ammeter resistance knob is turned to the out position, turn on lights and other electrical accessories to prevent battery overcharge. Increase the engine speed until output remains constant. The current setting with the unit at operating temperature should be from 34 to 36 amperes.

NOTE—The engine should be run at medium speed at least ten minutes before making any checks or adjustments on the regulator. This is necessary to bring the regulator up to operating temperature.

1. Current setting of the regulator is adjusted by bending the spiral spring hanger down to increase the current setting, or bending up on the spring hanger to decrease spring tension and lower current setting, Fig. 27. Normally,

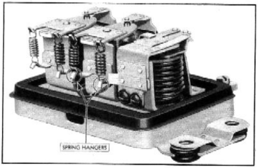

Fig. 27—Current Regulator Lower Spring Hanger

all adjustments should be made on one spring and the other spring should not be touched.

If the unit is badly out of adjustment it may be necessary to remove one tension spring and adjust by means of the other tension spring only for its proper setting. With the generator operating at medium speed, adjust the tension of the one spring by bending its spring hanger up or down until the current regulator unit operates at approximately 17 amperes. Next install the second spring and complete adjustments entirely on this spring to 34 to 36 amperes as previously explained without again touching the first spring. The final adjustment must be made lightly on the second spring.

2. In some cases it may be necessary to readjust the air gap between the armature and core. To check this adjustment push the armature down all the way by hand, then allow it to come back up until points are just touching. Then measure the air gap, which should be from .075" to .085". Adjustment of this air gap may be made by loosening the screws, Fig. 29, which mount the upper contact support. The support may then be moved up or down as required to provide an air gap of .075" to .085".

NOTE—Be sure points are lined up and tighten screws down well after adjustment.

VOLTAGE REGULATOR

When checking the voltage regulator, connect the volt ammeter tester to the regulator as follows:

Remove the battery wire from the battery terminal of the regulator and connect the positive lead of the ammeter to the battery terminal and the negative lead to the battery wire.

Then connect the positive lead of the voltmeter to the battery terminal of the regulator and the negative lead to a good ground, Fig. 28. Start the engine and run it at a speed equivalent to approximately 30 M.P.H.

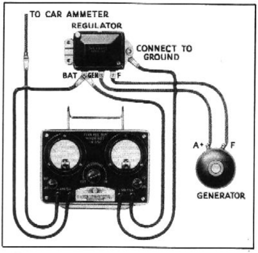

Fig. 28—Volt Ammeter Connections for Checking Voltage Regulator

If the output is less than 8 amperes, turn on lights to permit increased generator output, then cut in the resistance on the volt amperage tester by turning the resistance knob to the right until the output is reduced to 8 to 10 amperes. Operate the generator at this speed for at least 10 minutes to bring the regulator up to operating temperature. Retard the generator speed until the circuit breaker points open, then bring generator back to speed and note voltage setting, which should be from 7.2 to 7.4 volts.

NOTE—When checking voltage regulator setting the regulator cover must be in place.

VOLTAGE SETTING

Stop the engine and remove the regulator cover. The voltage setting of the regulator is adjusted by bending the spiral spring hanger down to increase the spring tension and increase the voltage setting, or by bending the spring hanger up to decrease the spring tension and lower the voltage, Fig. 25. Normally, all adjustments should be made on one spring and the other spring should not be touched.

On voltage regulators that are badly out of adjustment after the points have been cleaned and the air gap set, it may be necessary to check the adjustment of the second spring. To do this remove

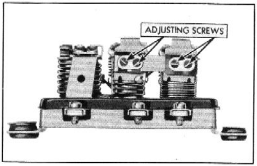

Fig. 29—Air Gap Adjusting Screws

one spring from the regulator; connect the positive lead of the voltmeter to the generator terminal of the regulator and the negative lead to a good ground. Depress the voltage regulator armature by hand to open the points. Slowly increase the generator speed until the voltmeter reads approximately 3 volts. Release the armature and adjust the spring hanger up or down to secure a voltage reading of 4.5 to 5 volts. Install the other spring and complete the adjustment to 7.2 to 7.4 volts entirely on this spring, as previously explained, without again touching the other spring.

NOTE—When the above adjustments are being made, the unit must be at operating temperature and the cover must be in place when voltage readings are taken.

After any adjustments, replace the cover, start the engine, and set it to run at a speed equivalent to 30 to 35 miles per hour. Readjust the variable resistance in the volt ammeter to obtain a generator output of 8 to 10 amperes. Now check the regulator voltage, which should be within the limits given above.

NOTE—Only a slight bend of the lower spring hanger is necessary to change the voltage setting.

In case the voltage does not respond to a slight movement of the spring hanger the following adjustments are necessary:

1. Clean the regulator points according to instructions given in the repair section.
2. Adjustment of the air gap—Push the armature down all the way by hand. Allow it to come back up until points are just closing; then measure the air gap with a feeler gauge. The distance between the armature and the core should be .075" to .085". The air gap may be adjusted by loosening the two upper contact mounting screws, Fig. 29, and moving the upper contact support up or down as required to secure the proper air gap. Be sure that points are lined up and tighten screws down well after adjustment.

CLEANING CONTACT POINTS

Cleaning the contact points of the current and voltage regulator properly is one of the most important operations the service man will be called

on to perform. Dirty or oxidized contact points arc and burn, cause reduced generator output, and run down batteries. If the points are properly cleaned the regulator will be restored to normal operation. If improperly cleaned improvement in performance will be small and only temporary.

Remove the upper contact support, so that each point may be properly and separately cleaned. Use a thin fine-cut ignition point file and file each point separately. Do not use the file excessively on the rounded (smaller) point. If a cavity is found in the flat point, clean it out with a spoon or riffler file, Fig. 30. Make sure the cavity is actually

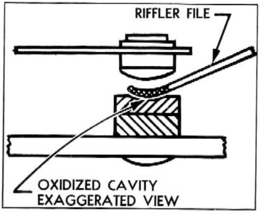

Fig. 30—Cleaning Regulator Point

cleaned out, so good clean contact is made between the points. Reassemble contact supports, paying particular attention to the position of the insulators, and adjust the air gap.

NOTE—Never use sandpaper or emery cloth to clean the contact points.

REVERSE POLARITY

If the polarity of the generator is reversed the circuit breaker contact points will vibrate and burn. To make sure the generator has the correct polarity after connecting it with the regulator, momentarily connect a jumper lead between the generator (GEN) terminal and the battery (BAT) terminal of the regulator before starting the engine. The momentary surge of battery current to the generator will correctly polarize the generator.

RADIO BY-PASS CONDENSER

The installation of radio by-pass condensers of too high capacity on the field terminal of the regulator or generator will cause the current and voltage regulator contact points to oxidize. Oxidized points cause a high resistance and may result in a low charging rate and a discharged battery. DO NOT CONNECT RADIO BY-PASS CONDENSERS TO THE FIELD TERMINAL OF THE REGULATOR OR GENERATOR other than as furnished with the short wave radio set which is .01 mmfd. capacity.

If a condenser has been installed to the field terminal, disconnect condenser and clean the contact points of both the current and voltage regulator as explained under the heading "Cleaning Contact Points."

THE STARTING SYSTEM

The starting system has only one function to perform—it cranks the engine in the same manner as was formerly done by hand. In the starting system, there are three units: the battery, the starting switch and the starting motor. (Figure 31.)

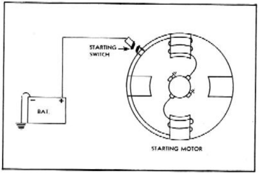

Fig. 31—Starting Motor Circuit

The battery supplies the energy, the switch completes the circuit, allowing this energy to flow to the starting motor. The motor then delivers mechanical energy and does the actual work of cranking the engine. The starting equipment is used for a short time only and then remains idle until it is again needed to start the engine. The battery, however, performs other functions.

It should be noted that the starting motor draws a large amount of current for a short period of time, whereas the generator replaces this current by charging the battery at a lower rate for a much longer period of time.

THE STARTING MOTOR

The starting motor is similar in construction and appearance to the generator, but the design of the parts are different. Both motor and generator require frame, field coils, armature, brushes, etc. The operation of the starting motor is the reverse of the generator. In the case of the generator, a loop of wire is revolved in the magnetic field and generates current. In the case of a starting motor, current is supplied to the loop which lies in a magnetic field. As the loop rotates, mechanical energy is produced.

The starting motor is designed to incorporate a Manual Shift Drive Mechanism which assures positive engagement of the starting motor pinion with the flywheel until the engine is started. (Figure 32.) This is of especial benefit when starting a cold engine, as the starting motor will continue to crank the engine as long as the driver depresses the starter pedal.

In this design, the starter pinion in conjunction with an over-running clutch (or roller clutch), a compression spring and a pulley-like sheave are mounted as an assembly on the splined part of the armature shaft. The sheave and spring are mounted to rotate freely on the outer diameter of the tube portion of the assembly. (See Figure 32.)

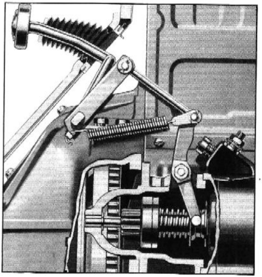

Fig. 32—Starting Motor Drive

A multiple spring and roller over-running mechanism (Figure 33), similar to that of a bicycle coaster brake, is located between the outer part of the clutch which is attached to the pinion and the inner part which is splined to the armature shaft.

A lever bolted at its fulcrum to the starting motor housing has a yoke at its lower end which straddles the sheave, integral bosses on its inner sides engage

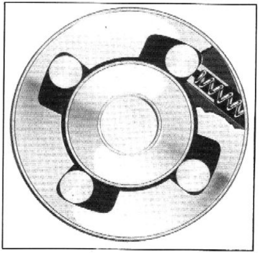

Fig. 33—Over-running Clutch

the sheave grooves. Its upper end connects to the starter pedal through linkage.

When cranking the engine, depressing the starter pedal causes the lever to shift the pinion gear into mesh with flywheel teeth. Further pedal movement brings an offset portion of the lever into contact with the button on the starter switch, thereby closing the switch contacts. In case the pinion gear is stopped when engaging the flywheel teeth, the compression spring allows the sheave to move along the sleeve, permitting the lever to close the starter switch contacts. The instant the armature starts to rotate, the compression spring pushes the pinion gear into full mesh with the flywheel immediately. (See Figure 32.)

After the engine fires, and before the pinion can be withdrawn from the flywheel teeth, the over-running clutch allows the pinion to spin freely on the armature shaft. The tension of starter pedal return spring holds the pinion out of mesh with the flywheel while the engine is operating.

Maintenance

Lubricate the hinge cap oiler with 8 to 10 drops of light engine oil every 1,000 miles.

The cover band should be removed periodically and the brushes and commutator inspected. If the commutator is dirty, it may be cleaned with No. 00 sandpaper, then blow out the dust with compressed air.

If weak brush springs are indicated their tension may be checked with a spring scale. The tension necessary to lift the brush so it just clears the commutator is 24 to 28 ounces.

Disassembly of Starting Motor

Before a starting motor is removed from an engine, certain tests should be made to be sure that the starting motor needs repairing. First check the battery. If the specific gravity is below 1.175, the battery is discharged and should be recharged. Check the battery ground connection at the frame and clean and tighten if necessary. Check the battery terminals. Dirty terminals result in poor connection between the battery and the electrical units. They should be cleaned regularly and the battery washed off with a solution of bicarbonate of soda and water, or ammonia and water.

Remove the starting motor switch and check the contacts to be sure that they are clean and not burned or corroded. If after making the foregoing inspections and the starting motor still does not function, it should be removed from the truck and disassembled.

To disassemble—remove the starting motor switch, commutator cover band, through bolts and rear housing. Remove the field coil to brush lead machine screws and remove the commutator end frame assembly and then remove the armature.

To remove the drive mechanism, first remove the bolt on which the shift lever pivots and then remove the shift lever and drive mechanism.

After the starting motor has been completely disassembled, wash all parts in cleaning solvent with the exception of the over-running clutch.

The illustration (Figure 34) shows a layout of the starting motor parts. The reader should study the illustration so he will be familiar with the name and location of the various parts which make up the starting motor.

Testing Starting Motor Parts

Field Coil Test for Continuous Circuit: Place the test prod leads on the field coil leads. If the test lamp lights, the field coils are OK. If the test lamp does not light, there is an open circuit in one or both of the field coils.

Field Coil Test for Ground: Place one test prod lead to frame and the other to the field coil lead. If the test lamp does not light, the field coils are OK. If the test lamp lights, one or both field coils are grounded.

Individual Field Coil Test for Ground: Break soldered connection between the two field coils and test each one separately replacing the field coil that is grounded.

Field Coil Leads: Inspect the field coil leads where they are soldered at the starting switch terminal to be sure that they are tight.

Armature Test for Ground: Place one test prod on the armature and the other on the commutator. If the test lamp lights, the armature is grounded and should be replaced. If the test lamp does not light, the armature is OK.

Armature Test for Short Circuit: Place the armature on the growler, and with a hack saw blade over the armature core, rotate the armature and test. If the saw blade does not vibrate, the armature is OK. If the saw blade vibrates the armature is short-circuited and should be replaced.

Commutator: Inspect the commutator for roughness or burned bars; burned bars usually indicate open circuited coils which in most cases is caused by coil leads being loose in the commutator riser bars. Loose leads should be resoldered using a rosin flux. After soldering, the commutator should be turned down on a lathe until it is thoroughly cleaned up, then sand it off smooth with No. 00 sandpaper. After a commutator has been resoldered, the armature should be tested on the growler to make sure the armature has not been shorted during the soldering process.

Insulated Brush Holder Test for Ground. Place one test prod lead to the cover and the other on the brush holder. If the test lamp lights, brush holder is grounded and should be replaced. If the test lamp does not light, the brush holder is OK.

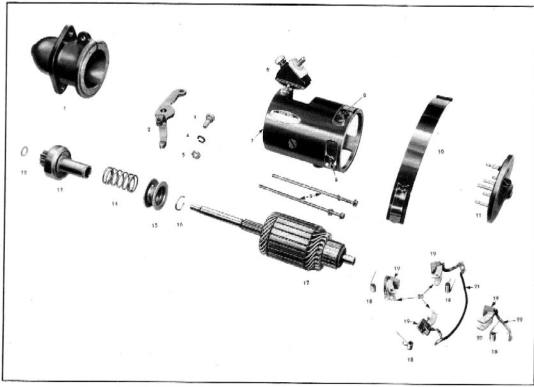

Fig. 34—Layout of Starting Motor Parts

1—Drive Housing
2—Shift Lever
3—Bolt (Shift Lever)
4—Lockwasher
5—Nut
6—Switch
7—Field Frame
8—Field Coil
9—Through Bolt
10—Band
11—Brush Holder Frame with Pins
12—End Spacer
13—Starter Drive Shaft and Pinion
14—Spring
15—Sheave
16—Snap Ring
17—Armature
18—Brush Spring
19—Brush
20—Brush Holder
21—Brush Field Lead
22—Brush to Ground Lead

Brushes: Check the condition of the brushes and if they are pitted or worn, they should be replaced. Check the tension of the brush holder springs; they should have enough tension to hold the brushes snugly against the commutator.

Brush Ground Leads: Disconnect the brush ground leads from the end frame and clean all terminals and replace. Check the insulation of the brush to field coil leads. The insulation should not be broken.

Rear Housing Bushing: Check the condition of the housing bushing. The armature shaft should fit snugly in this bushing; if it is worn it should be replaced.

Reassembly of Starting Motor

Thread the shift lever through the slot in the rear housing, while at the same time engaging the bosses on the inner end of the lever in the sheave grooves on the drive mechanism, then slide the lever and the drive into the housing together, assemble the pivot bolt through the shift lever to the housing.

Assemble commutator end washer and commutator end frame assembly to the armature. Assemble the armature and commutator end frame assembly to the starting motor housing. Thread the armature shaft through the drive mechanism, making sure to install the thrust washer between the drive and the rear bushing. Install the through bolts and tighten them securely.

Assemble the field coil to brush lead machine screws. Oil commutator end frame bushing.

Connect the starting motor to a battery and operate for running test. Assemble commutator band cover and install the starting switch insulators in the switch and assemble the switch to the motor. Replace starting motor on engine, making sure all connections are clean and tight.

THE STARTING SWITCH

The starting switch is designed to carry the heavy current required by the starting motor without loss and without heating.

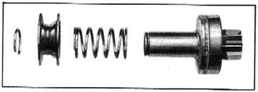

Fig. 35—Starting Motor Drive Mechanism

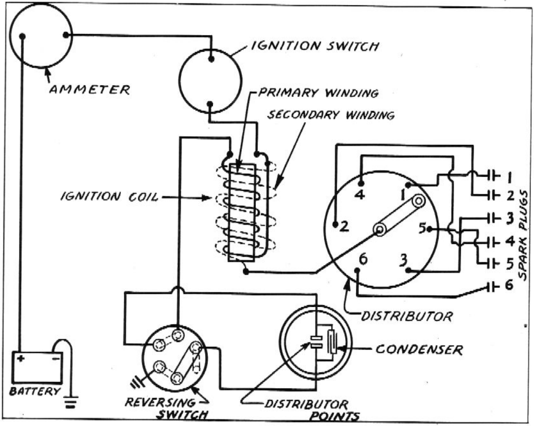

Fig. 36—Ignition Circuits

The contacts are arranged to provide a wedging action, thus insuring a good connection when the contacts are brought together and also giving the contacts a wiping action which tends to keep them clean.

DRIVE MECHANISM

The drive pinion and over-running clutch is a self-contained unit and if it becomes damaged in any way the complete unit should be replaced. However, should the spring be broken or the sheave become worn, these parts may be easily replaced by compressing the spring to uncover the lock ring in the tube part of the drive mechanism. Removal of the lock ring permits removal and replacement of both the sheave and spring. Figure 35 shows a layout of the drive mechanism parts.

THE IGNITION SYSTEM

The power in a gasoline engine is derived from burning a gas and air mixture in the engine cylinders. In order to ignite this gas, the electric spark is made to jump a small gap inside the cylinder. The ignition system furnishes this spark. The spark must occur in each cylinder at exactly the proper time and the sparks in the various cylinders must follow each other in the proper order. To accomplish this, the following parts are used: The battery which furnishes the electrical energy; the ignition coil which transforms the battery current to high tension current which will jump the gap in the spark plug; the mechanical breaker which opens and closes the primary circuit at the proper time; the distributor which delivers the spark to the

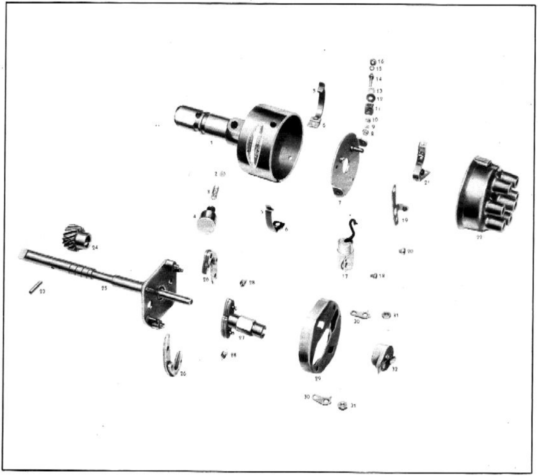

Fig. 37—Layout of Distributor Parts

1—Housing
2—Oil Wick
3—Wick Spring
4—Grease Cup
5—Cap Spring
6—Spring Support
7—Breaker Plate
8—Stud Nut
9—Lockwasher
10—Plain Washer
11—Bushing (Insulating)
12—Washer (Insulating)
13—Plain Washer
14—Terminal Stud
15—Lockwasher
16—Stud Nut
17—Condenser
18—Screw (Condenser Mounting)
19—Breaker Point (Adjustable)
20—Lock Screw (Breaker Point)
21—Breaker Point and Spring
22—Distributor Cap
23—Gear Pin
24—Driven Gear (Distributor)
25—Shaft and Plate
26—Weight (Spark Advance)
27—Cam (Distributor)
28—Weight Spring
29—Weight Stop
30—Weight Washer
31—Nut
32—Rotor

proper cylinders; the spark plug which provides the gap in the engine cylinder; the wiring which connects the various units; the ignition switch for disconnecting the battery when it is desired to stop the engine.

Operation

When the ignition switch is closed, current flows from the battery positive to the starter switch, over the wire to the ammeter and then to the ignition switch, through the switch to the coil. The current now passes through the primary winding to the reversing switch, through the switch to the distributor, across the breaker points and back to the reversing switch, then through the other set of contacts in the reversing switch to ground, and thence to the negative terminal of the battery, Fig. 36.

Current flowing through this circuit builds up a magnetic field about the coil. When the breaker points open, the current tends to keep on flowing and surges into the condenser, attracting a positive charge on one side and a negative charge on the other. A fraction of a second after the breaker points open, the counter pressure in the condenser overcomes the surge pressure on the line and the condenser discharges from the positively charged side back through the primary winding of the coil in the opposite direction to the primary current, and back to the other side of the condenser, equalizing the two sides of the condenser. The discharge current from the condenser, passing over the primary winding in the opposite direction to the magnetizing current tends to reverse the polarity of the coil and results in a very rapid demagnetizing of the coil. This action causes a very rapid movement of the lines of force across the large number of turns in the secondary winding which induces (or generates) a current of very high voltage which flows from the secondary winding to the high tension terminal of the coil, then to the distributor, across the distributor rotor and over the spark plug wire to the spark plug, across the plug gap to ground and back to the other end of the secondary winding, completing the circuit.

IGNITION DISTRIBUTOR

The ignition distributor is mounted on the right side of the engine and is driven from the camshaft by spiral gears. Spark control is entirely automatic, being operated by centrifugal weights pivoted on a plate which is an integral part of the shaft and connected to the breaker cam. This mechanism advances the timing automatically as the engine speed increases.

The illustration (Figure 37) shows an exploded view of the distributor parts.

Maintenance

Keep the grease cup filled with medium cup grease. Turn down the cup one turn every 1000 miles. Add a trace of petrolatum to the breaker cam and add a few drops of light engine oil in the wick in the top of the cam under the rotor every 1000 miles. The distributor cap should be removed at regular intervals and the contacts, rotor and cap examined. Check the high tension wiring for frayed or damaged insulation and poor connections at the caps or plugs. Any damaged parts should be replaced and loose connections tightened.

Contact points that are burned or pitted should be replaced or dressed down with a fine-cut ignition point file. The file should not be used on other metals and should not be allowed to become greasy or dirty. Never use emery cloth to clean contact points.

Oxidized points may be caused by high resistance or loose connections in condenser circuit, oil or dirt on the contact surfaces, or high voltage regulator setting. Check for these conditions where burned contact points are experienced.

DISTRIBUTOR OVERHAUL

Disassembly

1. Remove the lubrication cup, spring and fibre shaft contact.
2. Remove the movable contact point and condenser lead from the primary terminal and remove the terminal from the distributor body.
3. Remove the other primary terminal and the screws retaining the breaker plate in the distributor body.
4. Drive out the pin retaining the distributor gear on the shaft and remove the distributor and advance mechanism assembly from the distributor body.
5. Remove the advance springs. Bend back the tanks on the lock plates and remove the two nuts holding the advance mechanism cover and remove the cover.
6. Remove the cam and centrifugal weights. Wash all parts in cleaning solvent. Figure 38 shows the parts of the advance mechanism.

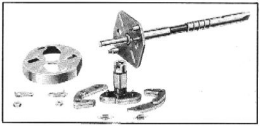

Fig. 38—Distributor Automatic Advance Mechanism

Inspection

1. Inspect the shaft for wear, and check its fit in the bearings in the distributor body. If the shaft or bearings are worn, the shaft and distributor body should be replaced.
2. Mount the shaft in "V" blocks and check the shaft alignment with a dial gauge. The runout should not exceed .002".
3. Inspect the centrifugal weights for wear or burrs and free fit on their pins.
4. Inspect the cam for wear or roughness. Then check its fit on the end of the shaft. It should be absolutely free without any looseness.

5. Inspect the condition of the distributor points —dirty points should be cleaned and badly pitted points should be replaced.
6. Test the condenser for series resistance, microfarad capacity and insulation breakdown, following the instructions given by the manufacturer of the test equipment used.

Reassembly

1. Assemble the centrifugal weights over their pivot pins. Lubricate the top end of the shaft with light engine oil and install the cam.
2. Assemble the advance mechanism cover. Install the two lock plates and nuts. After tightening the nuts securely, lock them by bending up the tangs on the lock plates.

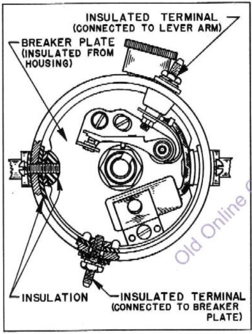

Fig. 39—Ignition Distributor Connections

3. Lubricate the shaft and install it in the distributor housing. Install the drive gear and pin.
4. Install the breaker plate in the distributor body, assemble breaker plate insulation. Then assemble the distributor cap retaining clips; the screws which mount the clips are screwed into insulation nuts on the inside of the breaker plate, Fig. 39.
5. Install the primary terminal insulation bushing in the housing. Thread the terminal through the bushing and install the insulation washer, flat washer, lockwasher and nut.
6. Assemble the condenser to the breaker plate, making sure the connections are clean.
7. Install the distributor points and set the gap at .018".
8. Install the fibre shaft contact, spring and grease cup.

ADJUSTING BREAKER POINTS

The contact points on the distributor are fixed in their mounts and are controlled by an eccentric screw moving the mounting plate. To adjust the gap of these points, proceed as follows: Remove the distributor cap and rotor. Hand crank the engine until the breaker arm cam follower is on the peak of the cam. The contact points are then opened the maximum distance. Loosen the lock screw and turn the eccentric adjusting screw, as shown in Fig. 40, to the right or left, increasing or decreasing the gap to .018". Tighten the lock screw.

Fig. 40—Adjusting Distributor Breaker Points

When installing new points it is advisable to set the gap at .020" to .022" to compensate for initial wear on the fiber cam follower while breaking in.

REVERSING SWITCH

A switch mounted on top of the starting motor as shown in Fig. 41, and operated by a connecting rod to the starter drive shift lever is used to reverse the direction of the current flowing through the primary circuit to the breaker points in the distributor each time the engine is started, without changing the polarity of the secondary circuit.

Change in the direction of current flow takes place each time the starter is operated. In other words during any one period the engine is running the current flows in the same direction until the engine is stopped. Upon operating the starter to start the engine, due to a connecting rod from the

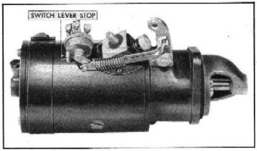

Fig. 41—Reversing Switch

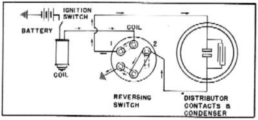

Fig. 42—Primary Circuit with Switch in One Position

starter drive shift lever to the reversing switch lever, the direction of current flow is changed or reversed from the direction of flow when the engine was last stopped. Figs. 42 and 43 show the two directions of current flow.

By this process of reversing the current flow in the primary circuit, ignition distributor point life is greatly lengthened, because the normal tendency of metal from one point to build up on the contact surface of the opposite point is reduced to a minimum. Likewise the recessing or pitting of the other point is practically eliminated. Transfer of metal from one point to the other will still take place every time the points are opened, or the circuit broken, with the reversing switch, but the transfer

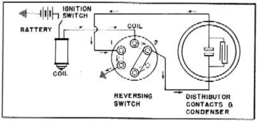

Fig. 43—Primary Circuit with Switch in Other Position

will be reversed when the current flow is reversed, resulting in each point gaining or losing like amounts of metal over a given period of time.

The illustration, Fig. 44, shows the parts of the reversing switch assembly.

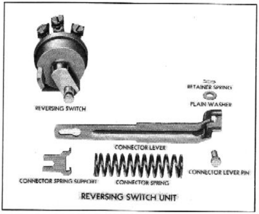

Fig. 44—Reversing Switch Parts

COIL

The ignition coil is filled with transformer oil and is hermetically sealed to prevent the entrance of moisture. A large porcelain insulator is used at the secondary terminal to provide effective insulation.

Coil tests can only be made on coil test equipment; therefore, the instructions of the equipment manufacturer should be followed.

SPARK PLUGS

The spark plugs are 10 millimeter AC-104. The gap setting is .040". Care must be used when installing plugs to prevent upsetting the spark plug gaps by overtightening the plugs. When installing spark plugs, use a new gasket and screw the plug in finger tight, then ½ to ¾ turn with a wrench. If a used gasket is being reinstalled, screw plug in finger tight, then ⅛ to ¼ turn with a wrench.

If a tension wrench is used the plugs should not be tightened over 15 foot pounds maximum.

THE GASOLINE GAUGE

The gasoline gauge is composed of two units, the indicating unit which is mounted on the instrument panel and the tank unit which is mounted on the gasoline tank. The circuit for this instrument passes through the ignition switch, therefore the gasoline gauge operates only when the ignition switch is "on."

Operation

When the gasoline tank is empty, current flows from the battery positive through the ammeter to the ignition switch and then to the dash unit top terminal. The current now passes through the choke or limiting coil to the common connection between the two coils, which is the lower terminal on the dash unit. At this point the current is offered two paths, one through the operating coil of the dash unit and the other over the wire to the tank unit. When the gasoline tank is empty, the contact finger cuts out all the resistance in the tank unit. The largest proportion of the current will pass through the tank unit circuit and only a very small portion through the operating coil of the dash

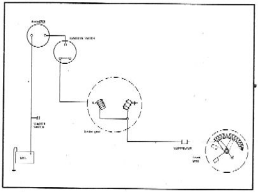

Fig. 45—Gasoline Gauge Circuits

unit, with the result that there is not sufficient current being forced through this circuit to move the hand in the dash unit. If the gasoline tank is half full, the cork float of the tank unit rises on the gasoline and moves the contact finger over the resistance, cutting resistance into the tank unit circuit as indicated by the dotted lines in Fig. 45.

As the tank is filled with gasoline, more current is passed through the operating coil and the reading, of course, is higher, and as the tank empties, less current is passed through the operating coil and the reading is lower.

If trouble is experienced with either the tank or dash unit, replacement of the unit is the only remedy.

The following is a procedure for locating trouble in the gasoline gauge using KMO-204, Gas Gauge Tester (Fig. 46).

A—1. With ignition switch "OFF," disconnect tank wire from back of Dash Unit. (This is the larger terminal.)

2. Attach the Red wire of the Tester to this terminal and Black wire to a good ground.

3. Turn ignition switch "ON"—move Tester arm up and down. Dash Unit should register "FULL" and "EMPTY" if it is OK. If so, turn ignition switch "OFF" and reconnect tank wire.

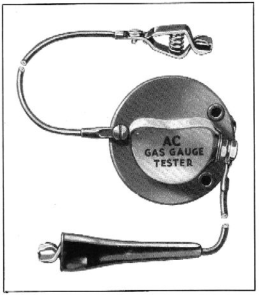

Fig. 46—Gasoline Gauge Tester

4. If Dash Unit does not register at all on above test—before replacing it make certain that it is getting current from the ignition switch. This can be quickly tested by connecting a 6-volt lamp from ignition terminal (left-hand terminal on back of Dash Unit) to ground.

B—If Dash Unit is OK, next check the wiring between Dash and Tank Units as follows:

1. Disconnect Tank Unit wire near the gas tank at the bayonet connection or terminal junction block.

2. Attach the Red wire of the Tester to the connection running to the dash and the Black wire to ground.

3. If on this test Dash Unit reads "EMPTY" at all times or the reading is noticeably lower than during the check at the Dash Unit, look for shorts or leaks in the wiring between dash and tank. Leaks are most liable to occur at terminal junctions. If Dash Unit reads above "FULL" at all times or if it reads higher at "EMPTY" and "FULL" than readings obtained when checking at the dash, look for poor connection or break in the wiring. Be sure contacts in bayonet connectors are clean.

C—1. If Dash Unit and wiring check OK, drop tank and remove Tank Unit. Clean away all dirt that has collected around Tank Unit terminal as road dirt, particularly calcium chloride, causes an electrical leak that will cause an error in reading.

2. After cleaning thoroughly, connect Tank Unit to the wire leading to dash, grounding the Tank Unit with a short piece of wire from the outer edge to any part of the truck. Turn ignition switch "ON" and move the float arm up and down. If this unit is OK, the Dash Unit will give corresponding "EMPTY" and "FULL" readings.

3. If Tank Unit is OK, reinstall in the Tank —if not, replace with a new Tank Unit, testing the new unit before installing in the tank.

NOTE—Always check tank units for freedom of movement of the float arm by raising it to various positions and observing that it will fall to "EMPTY" position in every instance.

ELECTRICAL SYSTEM WIRING

A simplified wiring diagram of the electrical system, Fig. 47, shows the electrical connections to all operating units on the trucks.

By studying this diagram the reader can gain an understanding of the circuits which operate the various units and lights in the electrical system.

LIGHTING SYSTEM

The lights are controlled by switches within easy reach of the driver. The lighting circuits are protected by a fuse located on the back of the lighting switch. In the event of a short circuit the fuse will burn out and thereby protect the wiring and the operating units. Whenever a fuse burns out the cause of burning the fuse should be located and corrected before replacing the fuse. Never replace a fuse with a piece of metal as there would be danger of starting a fire in addition to damaging the wiring or operating unit which had become short-circuited.

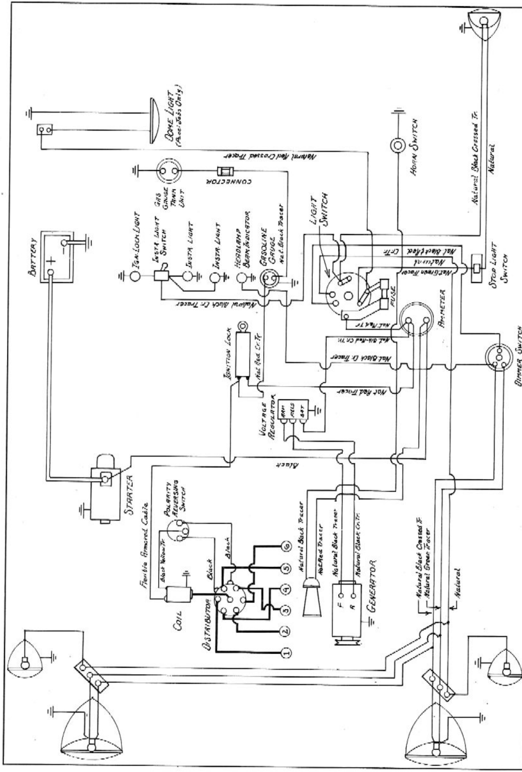

Fig. 47—Simplified Wiring Diagram

Switches

The main lighting switch has three positions. When the switch button is all the way in, all lights are turned off. Pulling the switch control button out to the first position turns on the parking lamps and tail lamp. When the switch button is pulled all the way out the headlight and tail light circuits are completed. The headlight upper and lower beams are controlled by a foot switch on the toe-board.

Stoplight and instrument lights are controlled by individual switches. The terminal side of the lighting switch is shown in Fig. 48. The connection table gives the color wire which should be connected to each terminal.

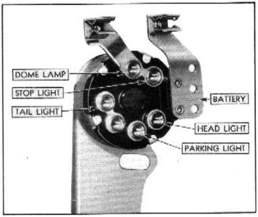

Fig. 48—Main Lighting Switch

LIGHTING SWITCH CONNECTIONS

Terminal	Wire Size No.	Wire Color
Battery	12	Natural with red tracer.
Headlight	12	Natural with black and red cross tracer.
Parking	16	Natural.
Tail Lamp	16	Natural with black cross tracer.
Stop Lamp	16	Natural with green tracer.
Dome Lamp		On models equipped with dome lamp the wire is located in the body and comes down the left body pillar.

Headlamps

Headlamps are the "Sealed Beam" type—that is, reflector, bulb and lens are a complete unit and can only be replaced as a unit.

The lower beam filament is positioned slightly to one side of the focal point in the reflector; this

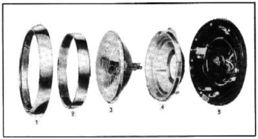

Fig. 49—Sealed Beam Headlamp Parts

1—Headlamp Rim
2—Retainer (Sealed Beam Unit)
3—Sealed Beam Unit
4—Sub-Body (Headlamp)
5—Housing (Headlamp)

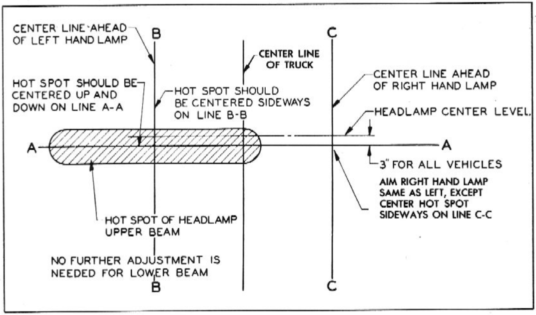

Fig. 50—Headlamp Aiming Diagram

results in deflecting the lower beam to the right side to illuminate the side of the road when meeting other vehicles on the highway.

To remove a burned out "Sealed Beam" unit, proceed as follows:

1. Remove the headlamp rim.
2. Remove the three screws which attach the unit retaining ring to the lamp housing. (Do not disturb aiming screws.)
3. Remove retainer ring, pull "Sealed Beam" unit forward and disconnect connector plug from "Sealed Beam" unit.
4. Install new unit by reversing above instructions.

NOTE—If the adjusting screws have not been disturbed, re-aiming of the headlamp will not be necessary.

Headlamp Aiming

Headlights may be aimed by use of an aiming screen, provided a clear space of 25 feet from the front of the headlamp to the screen is available. A portable screen is preferable because it simplifies the problem of centering the truck on the screen.

The screen should be made of light colored material and should have a black center line for use in centering the screen on the truck. The screen should also have two vertical black lines, one on each side of the center line and 25 inches from it. The screen should also be equipped with a movable horizontal tape which is also black.

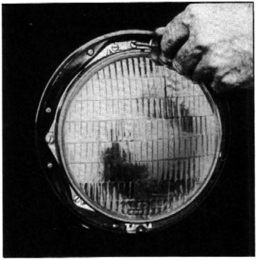

Fig. 51—Vertical Adjusting Screw

Place the truck on a level floor with the tires inflated to recommended specifications.

Place the screen 25 feet from the front of the truck and center the screen on the center line of the truck. This can be done by sighting through the back window and alongside the center division of the windshield.

Measure from the floor to the center of the headlamp and set the horizontal tape on the screen 3 inches less than this measurement from the floor.

Turn on the headlights (upper beam), cover one lamp and check the location of the beam on the screen. The center of the hot spot should be centered on the intersection of the vertical and horizontal lines on the screen as shown in Figure 50.

If the vertical aim is incorrect, remove the headlamp rim and turn the vertical adjusting screw shown in Fig. 51 until the light beam is centered on the horizontal line on the screen.

With the lamp rim removed, the horizontal aim may be adjusted by turning the horizontal adjusting screw as shown in Fig. 52, until the light beam is centered on the vertical line on the screen.

The other headlamp should be aimed in the same manner.

No further adjustment is needed for the traffic (lower) beam.

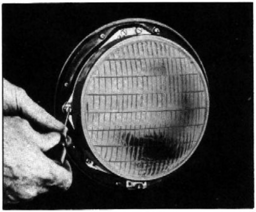

Fig. 52—Horizontal Adjusting Screw

The illumination output of headlamps is affected by a low battery, corroded battery terminals, loose connections in the lighting circuits and loose or dirty headlamp ground connections. Possibly the commonest cause of reduced illumination is dirty headlamp lenses, so being the case it is good policy to keep headlamp lens clean at all times.

ELECTRICAL SYSTEM TROUBLES AND REMEDIES

Symptom	Probable Remedy
Discharged Battery	
1. Loose or dirty terminals.	1. Clean and tighten terminals.
2. Generator not charging.	2. Inspect and test generator and regulator as instructed in this section.
3. Leak in wiring.	3. Check wiring for short circuit.
4. Excessive use of starting motor due to hard starting.	4. Tune engine completely as instructed in Section 6.
Starting Motor	
Slow Starter Speed:	
1. Discharged battery.	1. Recharge battery.
2. Loose or dirty terminals.	2. Clean and tighten terminals.
3. Worn brushes.	3. Replace brushes.
4. Sticking brushes.	4. Free up brushes, check brush spring tension.
5. Dirty commutator.	5. Clean commutator with sandpaper.
6. Worn drive end bushing.	6. Replace bushing.
7. Burned starter switch contacts.	7. Replace starter switch.
Generator	
Low Charging Rate:	
1. Dirty commutator.	1. Clean commutator.
2. Fan belt loose.	2. Adjust fan belt.
3. Voltage regulator improperly adjusted.	3. Adjust regulator according to instructions.
4. High resistance in charging circuit.	4. Clean and tighten battery terminals and check circuit for loose connections.
Too High Charging Rate:	
1. Current regulator improperly adjusted.	1. Adjust current regulator according to instructions.
Distributor	
Hard Starting:	
1. Distributor points burned or corroded.	1. Clean points or replace if necessary.
2. Points improperly adjusted.	2. Adjust points to .018".
3. Spark plugs improperly gapped.	3. Set plug gap at .040".
4. Spark plug wires loose and corroded in distributor cap.	4. Clean wire and cap terminals.
5. Loose connections in primary circuit.	5. Tighten all connections in primary circuit.
6. Corroded battery terminals.	6. Clean terminals thoroughly.
7. Series resistance in condenser circuit.	7. Clean all connections in condenser circuit.
8. Low capacity condenser.	8. Replace condenser.
Headlights	
Lights Burn Dim:	
1. Loose connections	1. Connection loose at terminal or ground connection loose on fender skirt.
2. Burned switch contacts.	2. Replace lighting or dimmer switch.
3. Corroded battery terminals.	3. Clean and tighten battery terminals.

TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling the Electrical System:

Tool No.	Description
KMO-330	Volt-Ampere Tester
KMO-204	Gas Gauge Tester

ELECTRICAL SYSTEM SPECIFICATIONS

BATTERY

Make	Delco
Model	15 x 3
Plates per Cell	15
Ampere Hour Capacity	100
Volts	6
Length	9"
Width	7"
Height	8⅝"
Specific Gravity:	
Fully Charged	1.275-1.300
Recharge at	1.200-1.240

STARTING MOTOR

Make	Delco-Remy
Model	1107054
Voltage	6
Lock Test:	
Amperes	525
Volts	3.4
Torque (ft. lbs.)	12
No Load Test:	
Amperes	65
Volts	5
R.P.M.	5000
Armature End Play	.005" to .050"
Commutator Out-of-Round	.003"

GENERATOR

Make	Delco-Remy
Model	1102667
Voltage	6-8
Armature End Play	.005"
Commutator Out-of-Round	.002"
Brush Spring Tension	14-18 oz.
Field Current at 6 Volts	1.7 to 1.9 Amps.

REGULATOR ASSEMBLY

Type	Current and Voltage—Vibrator

VOLTAGE REGULATOR UNIT

Voltage Setting (Open Circuit)	7.2-7.4 Volts (Hot)
Air Gap	.075"-.085"

CURRENT REGULATOR UNIT

Ampere Setting	34-36
Air Gap	.075"-.085"

CUT-OUT RELAY UNIT

Points Close—Volts (Hot)	6.3-6.7
Points Open—Amps. Reverse Current	0-4
Air Gap	.020"
Point Opening	.020"

DISTRIBUTOR

Make	Delco-Remy
Part Number	Delco-Remy 1110090
Type of Advance	Vacuum and Centrifugal
Vacuum Spark Advance Starts	800 R.P.M.
Spark Advance—Vacuum 24° at 2600 R.P.M.	
Maximum Advance at 3500 R.P.M.	36°
Timing—Initial Setting	5° B.T.C.
Firing Order	1-5-3-6-2-4
Breaker Point Gap	.018"
Breaker Arm Spring Tension	17-21 ozs.

SPARK PLUGS

Make	A.C.
Model	104
Size	10 mm.
Plug Gap	.040"

IGNITION COIL

Make	Delco-Remy
Model	1115145

HEADLAMPS

Type	Sealed Beam
Watts (Upper Beam)	45
Watts (Lower Beam)	35

LAMP BULB DATA

Lamp	Voltage	Candle Power	Contact	Trade No.
Headlamp (Sealed Beam)	6-8	45-35 (Watts)	Triple	4030
Instrument	6-8	1½	Single	55
Dome Lamp				
Carryall	6-8	15	Double	87
Panels	6-8	6	Double	81
Tail and Stop Lamps	6-8	3-21	Double	1154

Fuse

Location	On Light Switch
Type	SFE Cartridge
Amperes	30

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TM 10-1341

WAR DEPARTMENT

Washington, March 1, 1942

TM 10-1341, Maintenance Manual, Truck 1½-Ton (LC) 4 x 2, Chevrolet (Model 4109) published by the Chevrolet Motor Division, General Motors Corporation, is furnished for the information and guidance of all concerned.

[AG 062.11 (4-26-41) PC (C), June 10, 1941]

By order of the Secretary of War:

G. C. MARSHALL,
Chief of Staff

Official:
E. S. ADAMS,
Major General
The Adjutant General